HEIDENHAIN

Operating Instructions

PWM 8

Diagnostic Set

Software
246 199-11

03/2003

1. Contents

Note: *The successor is PWM 9, Id.Nr. 512 134-01.*
PWM 8 can be upgraded to PWM 9 by a hardware update.
The upgrade is available for a fee!
(More information: HEIDENHAIN Spare Parts Sales
Phone: +49 (86 69) 31-31 22)

2. General Information

2.1 Safety Instructions

Do not put defective units into operation!

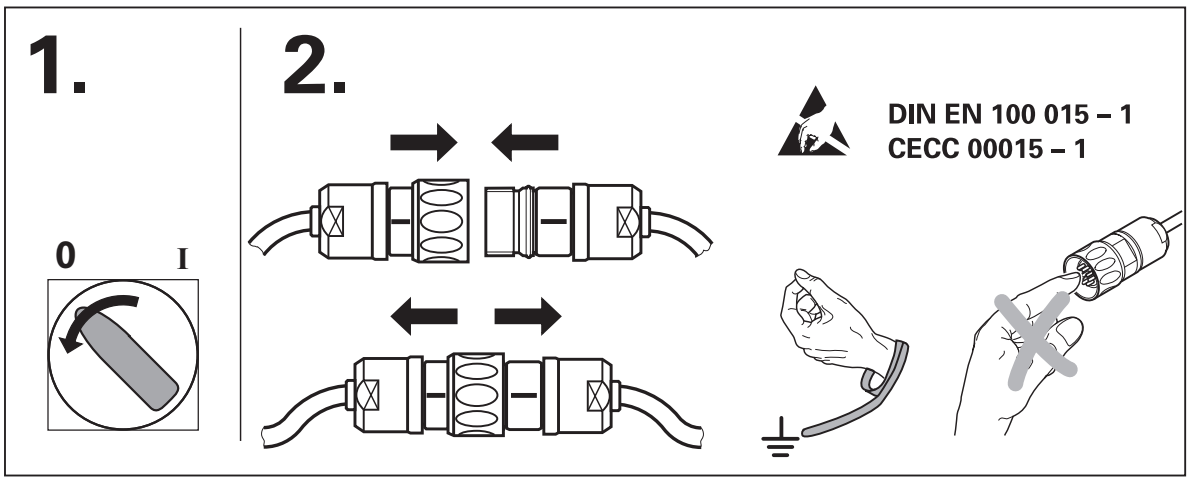


Fig 1: Connecting the PWM 8 in the position control loop of a machine tool controlled by TNC

In order to correctly judge the problems in a machine tool controlled by TNC, fundamental knowledge of the machine tool and its drives as well as their interaction with the measuring systems is required.

Inexpert handling may cause considerable damage and personal injury.

HEIDENHAIN is not liable for any damage or personal injury caused directly or indirectly or by improper use or incorrect operation.
Warning: Do not change any parameters or encoder voltages at the PWM while the machine tool is moving and a PWM is connected.

2.2 Description of the PWM 8 Phase Angle Measuring Unit

The PWM 8 phase angle measuring unit is a universal measuring unit for inspecting and adjusting HEIDENHAIN linear and rotary encoders.
The unit is operated by means of 5 soft keys. All values are displayed in a graphics display field. For each of the different encoder interfaces (11µApp, 1Vpp, TTL and HTL) a separate interface board is required. Each interface board is equipped with an encoder input (IN) and an encoder output (OUT). The unaltered scanning signals are available at the encoder output to be fed into e.g. a subsequent electronics. The PWM 8 may also be connected in series between the measuring system and the subsequent electronics. The axis functions of the machine tool are not impaired. It is also possible to use the PWM 8 separately for inspecting and adjusting measuring systems.

2.3 Functions of PWM 8

The main functions of PWM 8 are:
- Display of phase angle and on-to-off ratio
- Display of the scanning frequency
- Measurement of signal amplitude, current consumption and supply voltage of the encoder
- Display of the internal universal counter or the signal periods of a rotary encoder (pulse count)
- Display of reference signal, fault detection signal and counting direction
- Output of the amplified scanning signals (interface board: 11µApp, 1Vpp) or the original scanning signals (interface board: TTL, HTL) via 3 BNC sockets (e.g. to an oscilloscope)

The following functions are available in the EXPERT MODE:

- Input of a preset for the internal universal counter
- Encoder voltage selectable
- Settings (e.g. dialogue language) programmable via parameters

2.4 Power Supply

Possibilities of powering PWM 8

- Line-powered via a separate 24V power supply unit (standard set)
- By an external, non-floating dc voltage source of 10 - 30 V / approx. 1 Ampere (adapter cable supplied with PWM 8).
- Via the subsequent electronics; encoder, PWM 8 and subsequent electronics must be connected in series (Caution: power consumption of PWM 8 approx. 5.5W).
  The power supply of the measuring systems (external power supply unit or subsequent electronics) is selected via the soft keys of PWM 8.
  If a voltage is connected to the DC-IN socket of PWM 8, the PWM base unit is always operated with this voltage.

If PWM 8 and/or the encoder are to be powered via the subsequent electronics,

- the encoder monitoring function of the subsequent electronics is active;
- it can be selected, how the encoder voltage of the subsequent electronics is fed to the encoder via PWM 8:
  1. directly to the encoder (via parameter: P2 in EXPERT MODE)
  2. via the switching regulator (integrated in PWM 8) with potential segregation and possibility of setting the encoder voltage.

2.5 Items Supplied

Diagnostic Set		Items	Id.No.
Id.No. 312 431 01	Id.No. 312 431 02		
+	+	PWM 8	309 956 ..
+	Option	FST 2	251 697 ..
+	Option	ROD 450	295 455 A1
+	+	Power supply unit	313 797 ..
+	+	Power cord 240V~	223 775 01
+	+	Adapter 10-30V DC	317 293 01
+	+	BNC cable (3 pcs.)	254 150 02
+	+	Connecting cable 9-pin	309 773-01
+	+	Connecting cable 12-pin	298 399-01
+	+	Operating instructions	312 737 ..
+	Option	Interface board 11µApp	323 083 ..
Option	Option	Interface board 1Vpp	323 077 ..
Option	Option	Interface board TTL	323 079 ..
Option	Option	Interface board HTL	322 732 ..
Option	Option	Interface board Zn/Z1, EnDat, SSI	312 186 .. [1)]

[1)] Description of the Interface board Id. Nr. 312 186 .. in section 15.

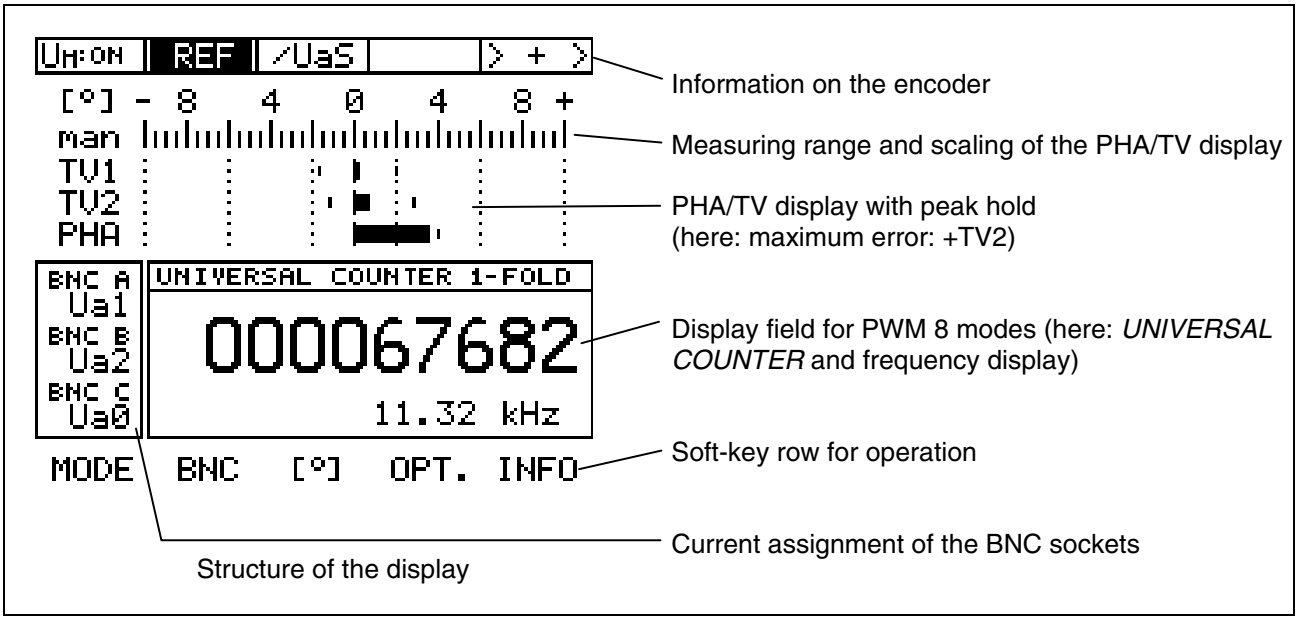
2.6 Software

For the PWM 8 phase angle measuring unit the following dialogues are available:

Dialogue	Software - Id.No.
English / German	246 199-xx
English / French	246 200-xx

The last two places (xx) of the Id.No. represent the software version.

2.7 Explanation of the Display



The following information is permanently displayed:
a): Information on the encoder:

UH:ON	Display: The supply voltage for the encoder is switched on.
UH:OFF	Display: The supply voltage for the encoder is switched off.
REF	Display: Reference signal (no reference signal available)
REF	The reference signal is displayed; no real-time display of the reference signal!
/UaS	Display: Fault detection signal (no fault detection signal generated)
/UaS ERROR	Fault detection signal generated, (active: low); at the same time the fault detection signal memory (ERROR) is set.
/UaS ERROR	No fault detection signal generated; the fault detection signal memory (ERROR) has been set by an earlier fault. The fault-detection memory can be deleted by: 1. activating another PWM 8 mode 2. switching the encoder voltage off and on 3. by pressing the soft key CLR ERROR of the INFO soft-key row.
> + >	Display of the counting direction: Encoder moves in forward direction
< - <	Display of the counting direction: Encoder moves in backward direction

b): Measuring range and scaling of the PHA/TV display:

Definitions:

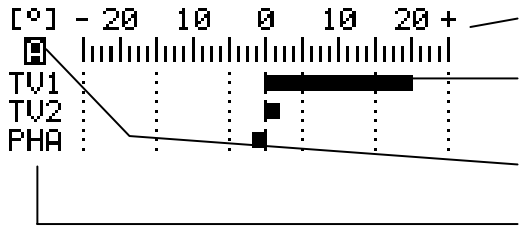
TV1, TV2 : On-to-off ratio incremental signal 1, incremental signal 2.
At the zero crossover analogue incremental signals are triggered, i.e. converted into square-wave signals. One period (= on-time plus off-time of a square-wave signal) is subdivided into 360°.
If on-time and off-time of a square-wave signal are the same, i.e. 180° each (180° + 180° = 360°), the on-to-off ratio is 0°. If the on-time of a square-wave signal exceeds the off-time, the on-to-off ratio is positive. An on-to-off ratio of e.g. +10° means the on-time of the square-wave signal is 190° (180° + 10°) and the off-time 170° (180° - 10°).

PHA: Phase angle error between incremental signal 1 and incremental signal 2.
If the incremental signal 1 leads the incremental signal 2 by 90°, the phase angle error is 0°. The phase angle error is the deviation from the optimum phase shift of 90° dimensioned in degrees.

PHA/TV Display:

PHA and TV are displayed as bars. The scaling of the PHA/TV display can be set for different measuring ranges.

With automatic switch-over of the measuring range the (graduated) range of the PHA/TV display is automatically adapted to the biggest error (longest bar).



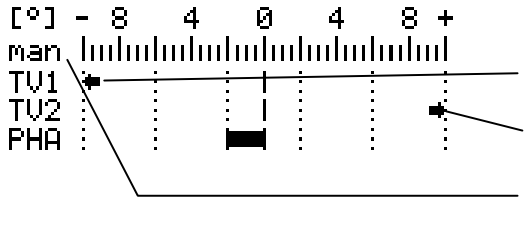
Measuring range of the PHA/TV display (here ± 25°)

With automatic switch-over of the measuring range the longest bar defines the measuring range.

Symbol for automatic switch-over of the measuring range.

Error display for: on-to-off ratio incremental signal 1 (TV1), on-to-off ratio incremental signal 2 (TV2), phase angle error between the two incremental signals (PHA)

If the measuring range is exceeded with manual switch-over of the measuring range, an error is displayed. Switching over the measuring range: see standard soft-key row in section 3.2



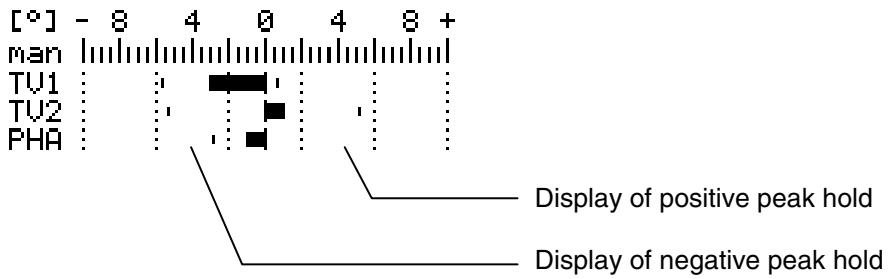
Measuring range exceeded in negative direction

Measuring range exceeded in positive direction

Manual switch-over of the measuring range

c): Peak hold of the PHA/TV display:

The peak hold holds and displays the maximum positive and negative value of the PHA/TV error.
It can be deleted by selecting a MODE or if the measuring range is exceeded. With automatic switch-over of the measuring range, peak hold is not active for PHA/TV display.



Display of positive peak hold

Display of negative peak hold

Manual start and stop of peak hold:
If the peak-hold display is to be valid only for a certain measuring range, it can be started and stopped by hand. Manual operation is made by means of the MODE soft-key row:

Soft key for manual control of the peak-hold display

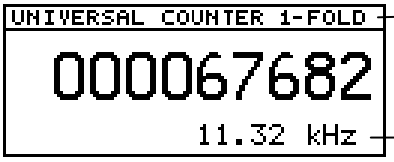
Soft key for manual start of the peak-hold display in standard operation. The already existing peak-hold display is deleted.

After pressing the START soft key the STOP soft key is displayed. If this soft key is pressed, the peak-hold display is frozen and the bars of the PHA/TV display are hidden. Now the peak-hold display can be read.

After pressing STOP, this soft key is displayed inverted which signals "frozen status". By pressing the inverted soft key, the peak-hold display switches back to its initial status (standard operation).

d): Display field for PWM 8 MODE:

All MODES are displayed in the MODE window:



Headline MODE
(here additionally: edge evaluation of the *UNIVERSAL COUNTER*))

Display field for the different MODES:

- *UNIVERSAL COUNTER*
- *DETERMINE PULSE NUMBER*
- *MEASURE CURRENT/VOLTAGE*
- *MEASURE AMPLITUDES*

See section 4, Description of the PWM 8 MODES

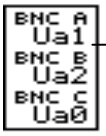
e): Soft-key row for operation of PWM 8:

The soft-key row makes PWM 8 easy to operate. It automatically configures itself according to the functions currently available.

Example: Soft-key row after power-on:

Standard setting of the soft-key row

f): Display field for the current assignment of the BNC sockets A, B and C:



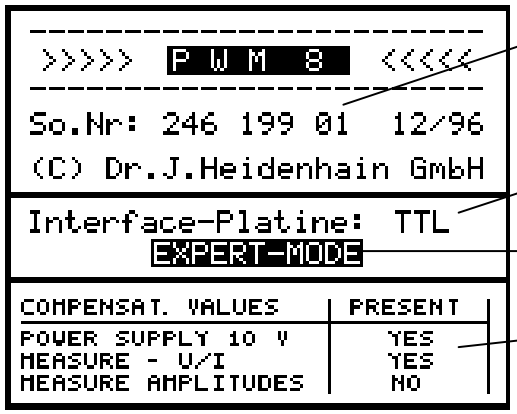
This field contains the encoder signals currently fed to the three BNC sockets BNC A, B and C.

2.8 Setting the Display Contrast

The contrast of the LC display of PWM 8 (Id.No. 309 956 X2) can be set from outside. The trimmer for contrast adjustment is located next to the BNC socket C. A trimming screwdriver is required to change the contrast. The contrast of PWM 8 units with the Id.No. 309 956 X1 can only be set internally.

3. Operation

3.1 Display after Power-On



Software-Id.No. 246 199-xx;
the last two places symbolize the software version (here: version 01)

Automatic recognition of the interface board (here: TTL interface)

EXPERT MODE is active;
see section 5

Software compensation data
(for calibration by HEIDENHAIN staff)

Note on software compensation data:
The software compensation display is intended for calibration by HEIDENHAIN staff.
The settings displayed can only be changed by HEIDENHAIN, Traunreut.

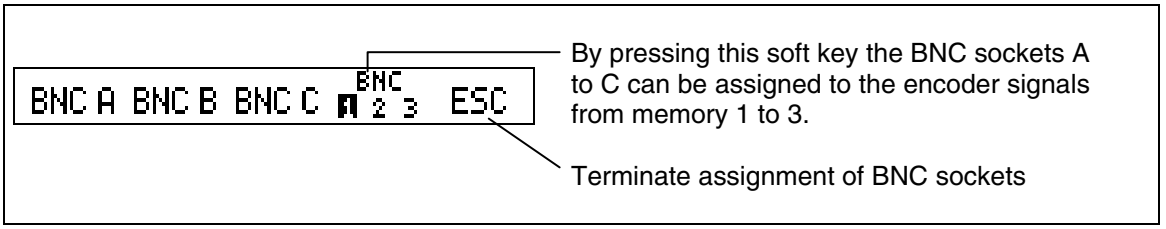
3.2 Standard Soft-Key Row

After the power-on display, the standard soft-key row is displayed.

Possibilities of setting the standard soft-key row:

MODE — Switches to the soft-key row PWM 8 MODE (see PWM 8 MODE in section 4)

BNC — Assignment of the BNC sockets A, B and C to different encoder signals; after pressing the BNC soft-key, you can choose from the following options:

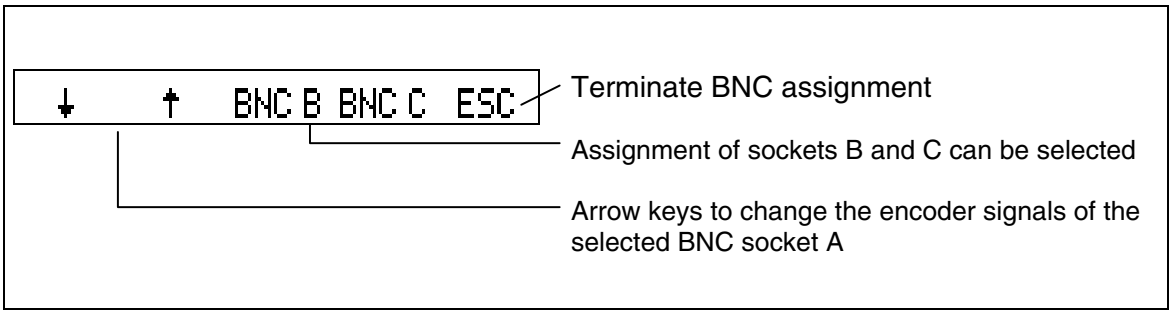


By pressing this soft key the BNC sockets A to C can be assigned to the encoder signals from memory 1 to 3.

Terminate assignment of BNC sockets

The default setting of the BNC memories made by HEIDENHAIN can be changed any time.

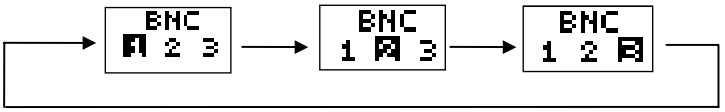
If e.g. the soft key BNC A is pressed, the assignment of the BNC socket A can be changed:



Switching the BNC memory:
The assignment of the BNC sockets is stored in three BNC memories that can be called successively.

Each time the soft key [BNC 1 2 3] is pressed, the next BNC memory is activated.

The display of the active BNC memory is highlighted:



Changing the signals in the BNC memories 1 to 3:
The signal in the active BNC memory is automatically stored each time it is changed by pressing the soft keys [↑] or [↓].
After power interruption the signals of the BNC memory active last are allocated to the BNC sockets.

Notes on the use of the BNC sockets:

- When using the BNC sockets to measure the encoder signals with an oscilloscope, be sure that the workstation and the operator are properly grounded!
- A floating oscilloscope should be used to display the encoder signals with as little interference as possible. Always connect the oscilloscope to the socket of the switch cabinet of the machine tool to avoid signal distortions caused by different ground potentials.

The following encoder signals can be connected with the BNC sockets:

Interface Board	Encoder signals on BNC socket			BNC memory
	BNC A	BNC B	BNC C	
11µApp	Ue1 U1+2 Ue0	Ue2 U1+2 Ue0	Ue0 NTR /UaS *)	1 2 3
1Vpp	A A+B R	B A+B R	R NTR /UaS *)	1 2 3
TTL, HTL	Ua1 /Ua1 Ua0	Ua2 /Ua2 /Ua0	Ua0 /Ua0 /UaS	1 2 3

*) Signal is generated in the PWM 8.

[°]

Switching over the measuring range of the PHA/TV scaling.
The following measuring ranges can be selected:

The scaling currently selected is highlighted. When choosing automatic scaling (auto), the scaling is adapted to the biggest error (longest bar).

OPT.

This soft key serves to activate the Options soft-key row.
The following functions are available:

Terminate *Options*

EXPERT-MODE; see section 5

The encoder can be powered *INTERNALLY* (by the power supply unit) or *EXTERNALLY* (by the subsequent electronics). Current setting: encoder powered *INTERNALLY*

The power supply for the encoder can be switched *ON* and *OFF*.

The terminating resistors for the scanning signals (with TTL or HTL and 1 Vpp interface board only) can be switched *ON* and *OFF*. The current setting is stored in PWM 8 and reloaded after power interruption.

Interface board	Terminating resistor [Ω]		
	0 V	+U encoder	Switch-able
TTL	91	215	yes
HTL	1200	1200	yes
1Vpp	121		yes [1)]
11µApp	not available		

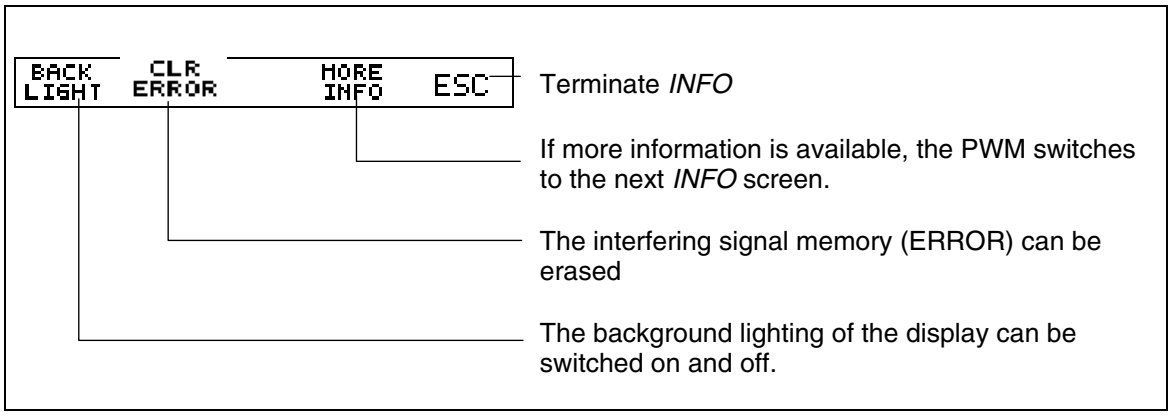
[1)] only possible with interface board Id.No. 323 077-XX or 312 246-01, index A

The active setting is highlighted in the Options soft-key row.

Note:

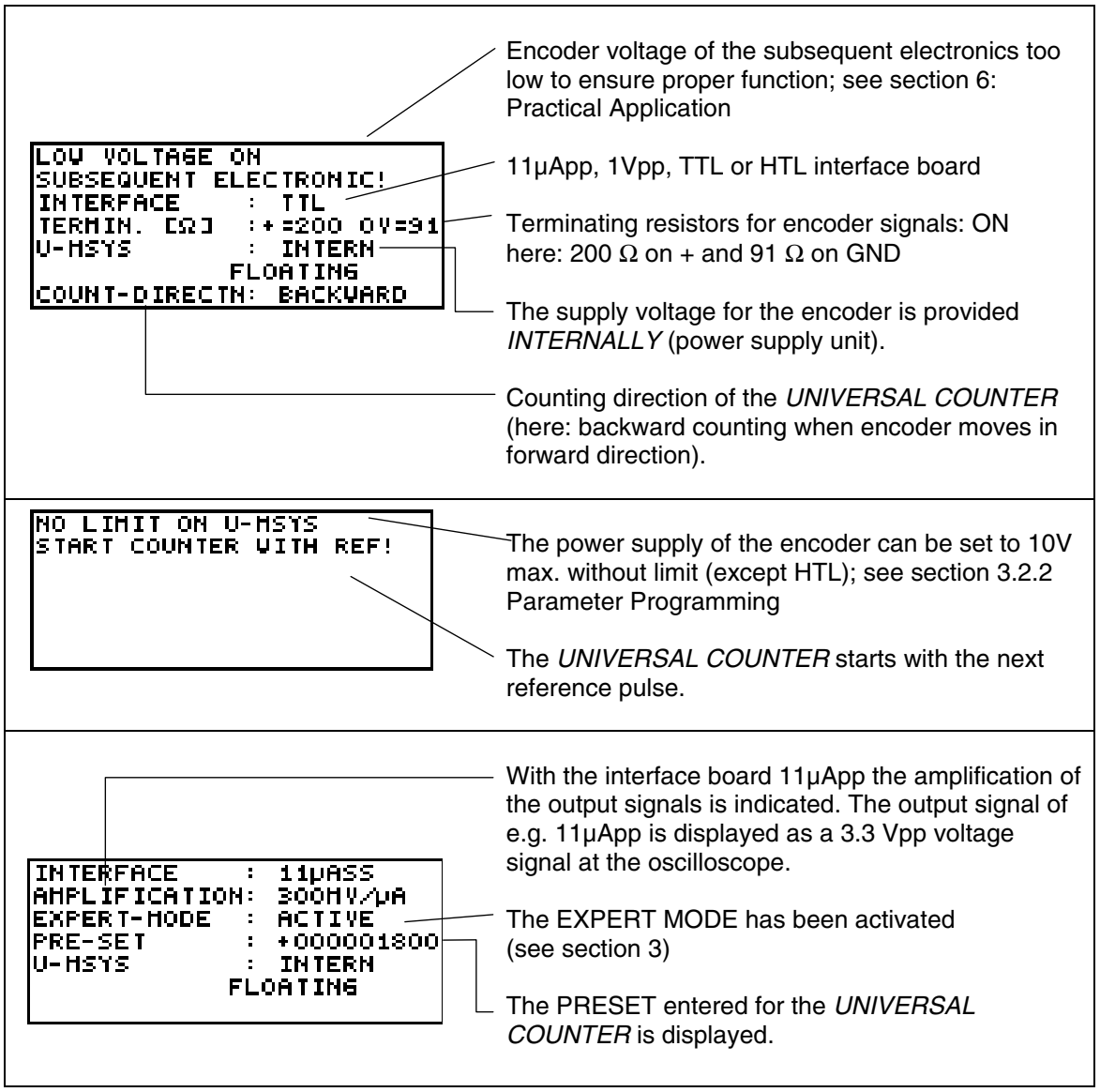
The soft key U-MSYS INT EXT is only displayed, if the PWM 8 is part of the encoder circuit, i.e. if a subsequent electronics (with encoder supply voltage) is connected to the encoder output of the interface board.

INFO This soft key serves to display the Info soft-key row:



Information on PWM 8 and on the interface board can be displayed on the INFO screen.

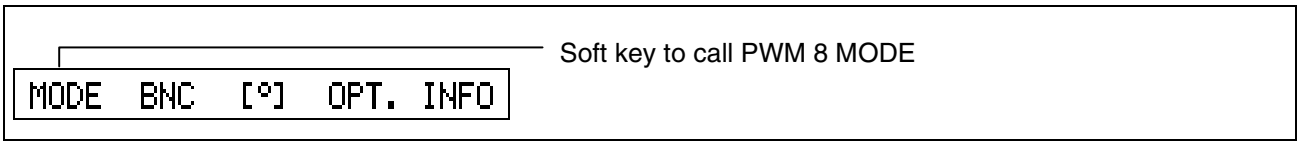
Possible displays:



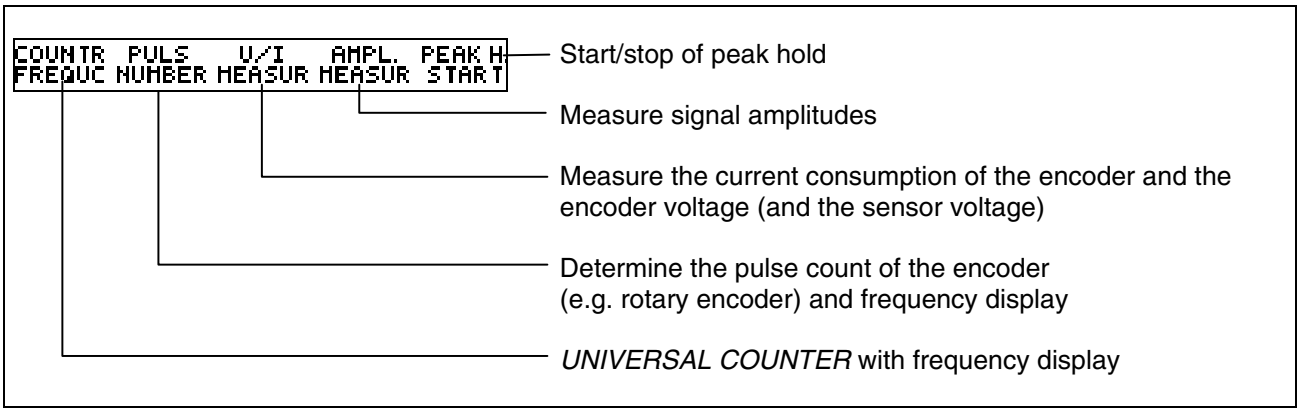
4. Description of the PWM 8 MODE

4.1 Switching the PWM 8 MODE

After the power-on message, the standard soft-key row is displayed, from which the MODE soft-key row of PWM 8 can be called:



The following PWM 8 modes can be selected from the MODE soft-key row:



For each PWM 8 MODE the following auxiliary displays are active:
(Description see section 2.7: Explanation of the display)

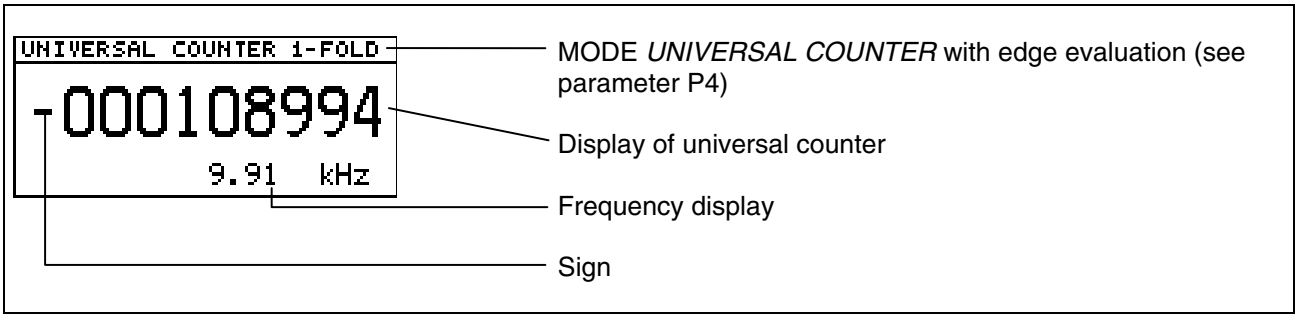
- Display of the reference signal
- Encoder monitor with memory function
- Display of the counting direction
- PHA/TV display
- Assignment of the BNC sockets

After power interruption the last active mode is loaded again.

4.2 PWM 8 MODE: UNIVERSAL COUNTER with Frequency Display

The UNIVERSAL COUNTER counts the triggered edges of the incremental signals 1 and 2 of the encoder.

Note:
The function of the UNIVERSAL COUNTER is defined by the counter parameters P5 to P7. The UNIVERSAL COUNTER can be loaded with a preset. See section 5: EXPERT MODE, parameters and PRESET editor.



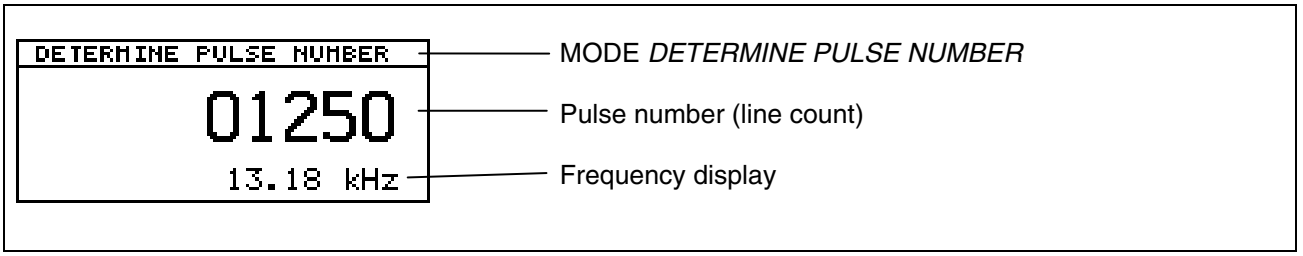
Clearing the *UNIVERSAL COUNTER*:

The UNIVERSAL COUNTER is cleared by pressing the soft key COUNTR FREQUC a second time.

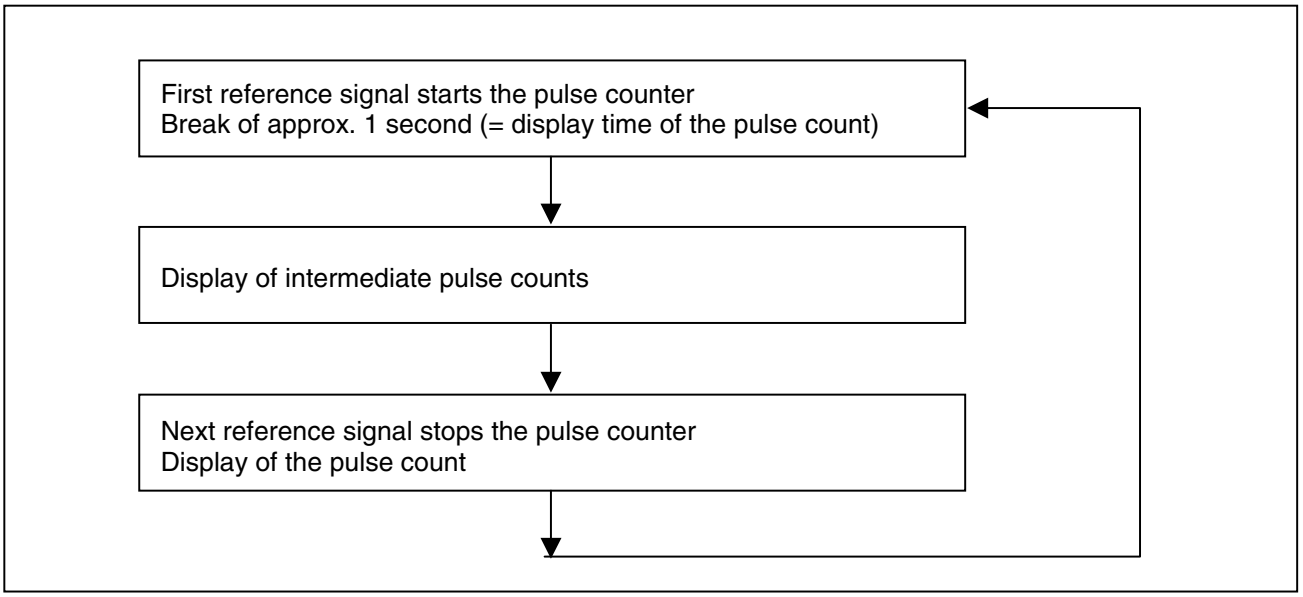
Frequency counter:
The frequency counter operates up to a frequency of 2 MHz.
The frequency is derived from the incremental signal 1.

4.3 PWM 8 MODE: *DETERMINE PULSE NUMBER* with Frequency Display

The MODE DETERMINE PULSE NUMBER is intended to find the pulse count of a rotary encoder.
The parameter P5: EDGE EVALUATION is automatically set to 1-fold, the parameter
P6: COUNTING MODE to 0-1-2!



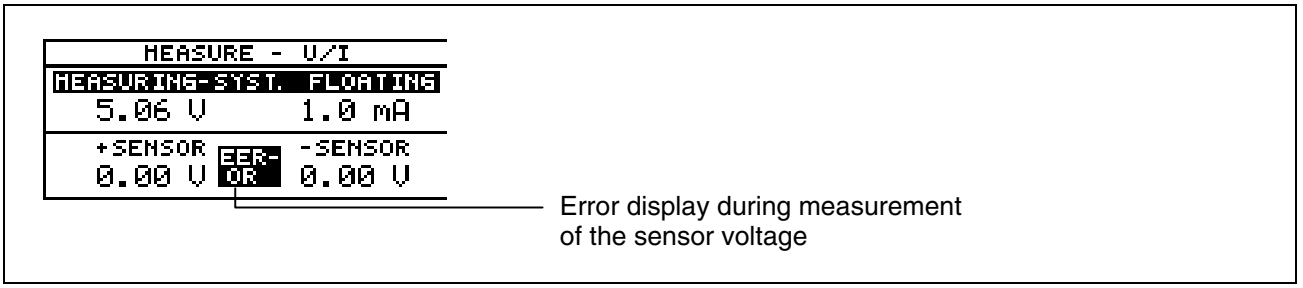
Proceeding to determine the pulse count:



Each time "DETERMINE PULSE NUMBER" is activated, the pulse counter is reset, i.e. the next reference signal starts the counter, the next but one stops it. This function can be of use e.g. when operating with measuring systems with distance-coded reference marks.

4.4 PWM 8 MODE: MEASURE U/I

The PWM MODE: MEASURE U/I the current consumption and the power supply of the encoder can be measured.
Depending on the interface board also the sensor voltages can be measured as well.
In the subsequent electronics the sensor lines serve to tap the encoder voltage directly at the encoder at high resistance and to feed it back to the subsequent electronics. Voltage drops on the supply lines of the encoders are then compensated in subsequent electronics offering compensation.
TTL, HTL and 1Vpp encoders are equipped with sensor lines.
If an error is detected during measurement of the sensor voltages, a blinking error field is displayed in MODE: MEASURE U/I.



A sensor-voltage error is displayed, if:
+ sensor smaller than 90 % of U-MSYS, or
- sensor larger than 10 % of U-MSYS

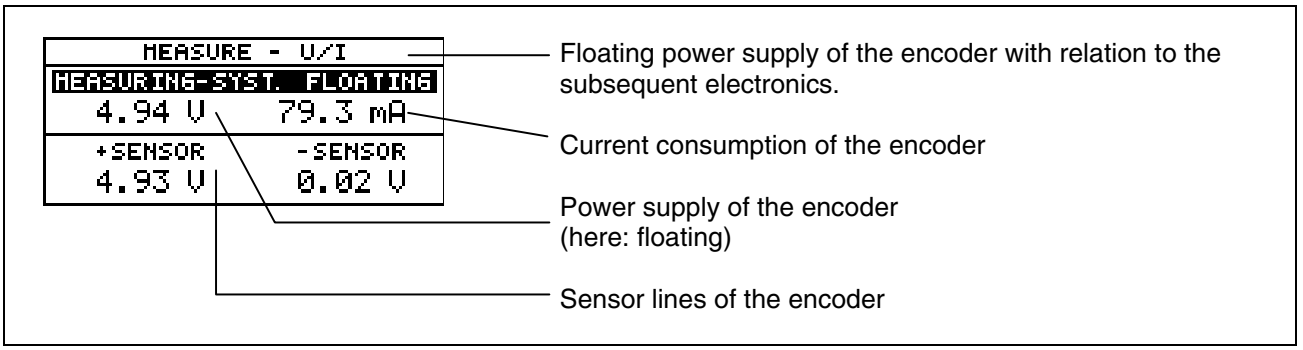
Note:
In the PWM 8 MODE: MEASURE U/I the supply lines of the encoder and the sensor lines are separated, whereas in all other PWM 8 MODES they are connected to each other!
The current consumption of the terminating resistors (with TTL and HTL interface boards) is displayed together with the current consumption of the encoder. I.e. **even if no encoder is connected, the current consumption of the encoder is displayed, if the terminating resistors and the encoder supply voltage are switched on.**

4.4.1 Display of the PWM 8 MODE: *MEASURE U/I* in the Mode Window

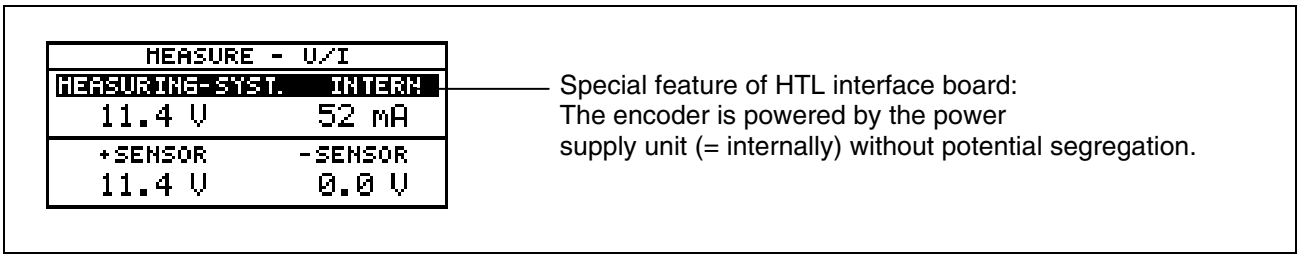
Depending on the power supply of the encoder and of PWM 8, the MODE MEASURE U/I may be displayed differently in the MODE window:

MODE: *MEASURE U/I* of encoders with sensor lines
(TTL, HTL, 1Vpp interface boards):

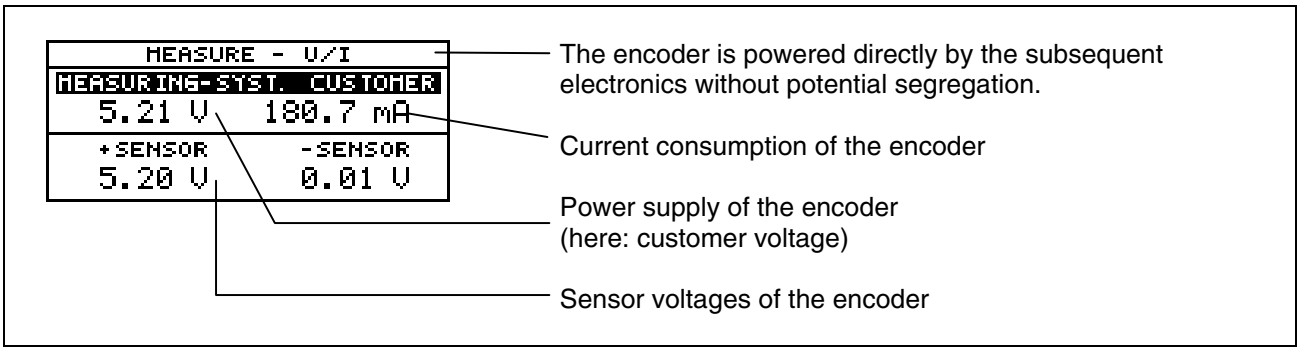
- and internally powered encoder (= via power supply unit) or
- externally powered encoder and parameter: P2 U-MSYS EXTERN = FLOATING



Special feature of HTL interface board:
A floating power supply of the encoder is not possible. The parameter P2 has no function.
The MODE MEASURE U/I is displayed as follows with HTL interface board:

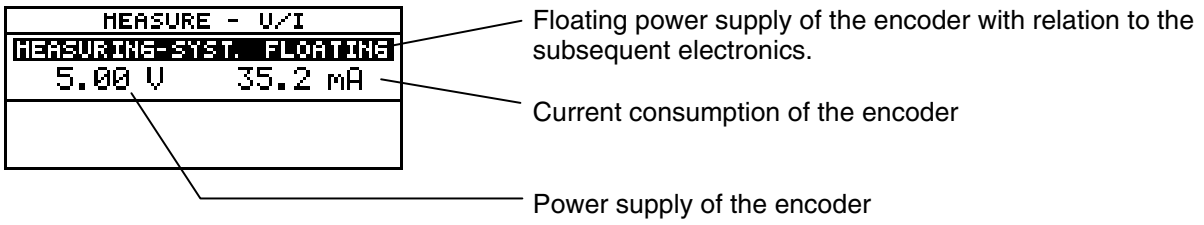


- externally powered encoder and parameter: P2 U-MSYS EXTERN = FROM CUSTOMER

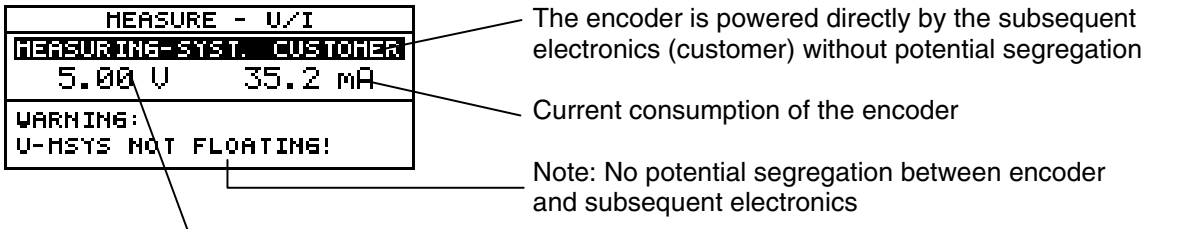


MODE: *MEASURE U/I* of encoders without sensor lines
(11µApp interface boards):

- und interner Meßsystemversorgung (= aus Externem Netzteil) oder
- externer Meßsystemversorgung und Parameter: *P2 U-MSYS EXTERN = POTENTIALFREI*



- externer Meßsystemversorgung und Parameter: *P2 U-MSYS EXTERN = VON KUNDE*



4.5 PWM 8 MODE: MEASURE AMPLITUDES

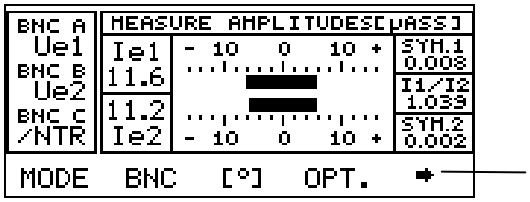
In this mode the vertices of the amplitudes of the incremental signals 1 and 2 are measured. The result always refers to an individual signal period. With sinusoidal encoder signals (11µApp and 1Vpp) the positive and the negative vertices are measured versus U0, with square-wave encoder signals (TTL and HTL) low and high level are measured versus 0V.

In the table below the maximum measuring ranges are listed for the different interface boards:

Interface board:	**11µApp**	**1Vpp**	**TTL**	**HTL**
Maximum measuring range	33 µApp	1.66 Vpp	low: 0 – 2.5 V high: 2.5 – 7.5 V	low: 0 – 7.5 V high: 7.5 – 22.5 V

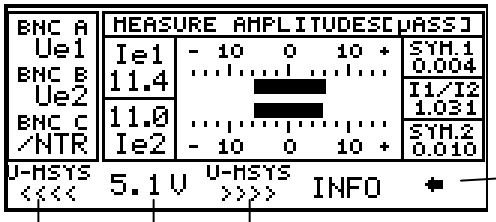
If the EXPERT MODE is active (see section 5) and the 11 µApp or 1Vpp interface board used, the encoder supply voltage can be set in the mode *MEASURE AMPLITUDES*:

For this purpose the standard soft-key row has been expanded by the soft key [➡] .



Soft key to switch to setting of encoder voltage

After pressing the soft key [➡] the encoder voltage can be set:



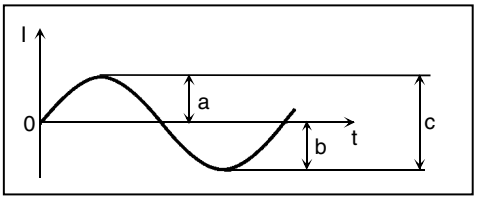
Soft key to switch back to the standard soft-key row

Display of encoder voltage

Soft keys to set the encoder voltage

4.5.1 Measuring the Signal Amplitudes with 11µApp Interface Board:

Definitions:



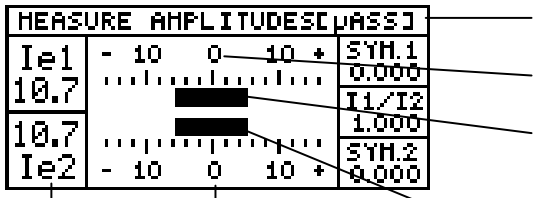
SYM.1: Symmetry 1, ratio of positive to negative half wave of incremental signal Ie1 (versus U_0)

SYM.2: Symmetry 2, ratio of positive to negative half wave of incremental signal Ie2 (versus U_0)

Calculation: $\left|\frac{\mathbf{a}-\mathbf{b}}{\mathbf{2}\times\mathbf{c}}\right|$ Result: ideal = 0

I1 / I2: Amplitude ratio, amplitudes of incremental signals Ie1 versus Ie2

Calculation: $\frac{C_{Ie1}}{C_{Ie2}}$ Result: ideal = 1



Result is displayed in µApp

Datum for measurement of sign. amplitude (U_0)

Bar display of incremental signal 1.
The position of the bars stands for the symmetry of the incremental signals.

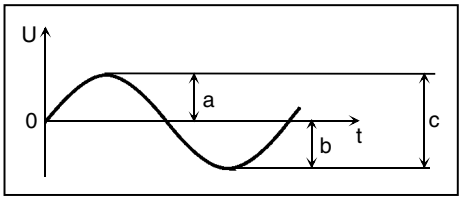
Bar display of incremental signal 2.

Range for measurement of the signal amplitude;
here: 33 µApp (± 16.5µApp)

Numerical peak-to-peak value of the signal amplitudes of the incremental signals 1 and 2 in µApp.

4.5.2 Measuring the Signal Amplitudes with 1Vpp Interface Board

Definitions:



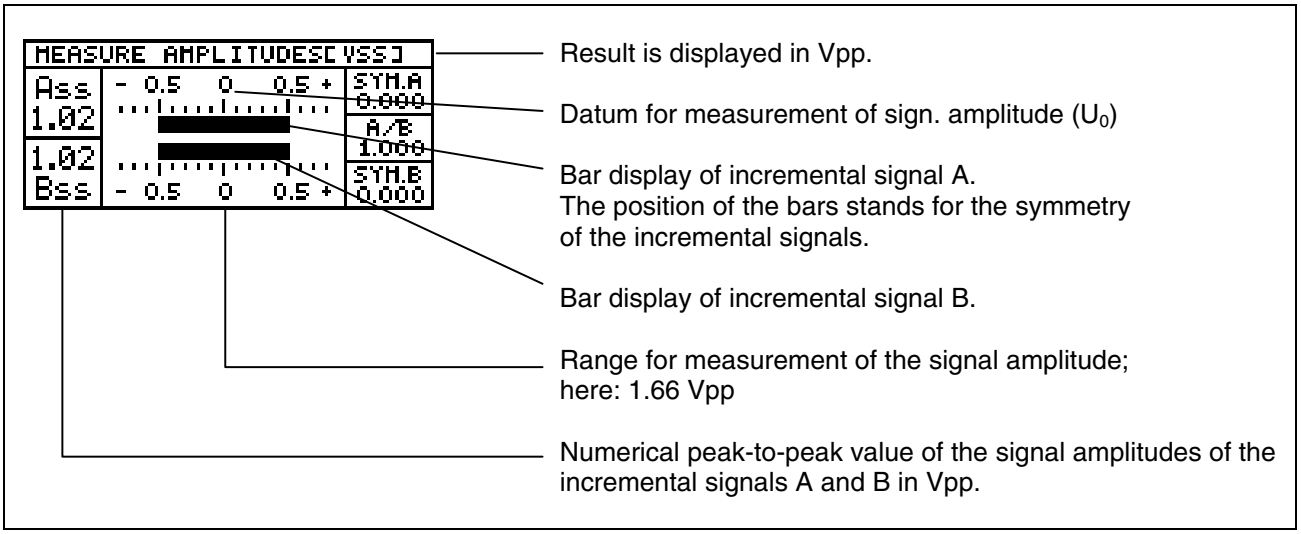
SYM.A: Symmetry A, ratio of positive to negative half wave of incremental signal A, (versus U_0).

SYM.B: Symmetry B, ratio of positive to negative half wave of incremental signal B, (versus U_0).

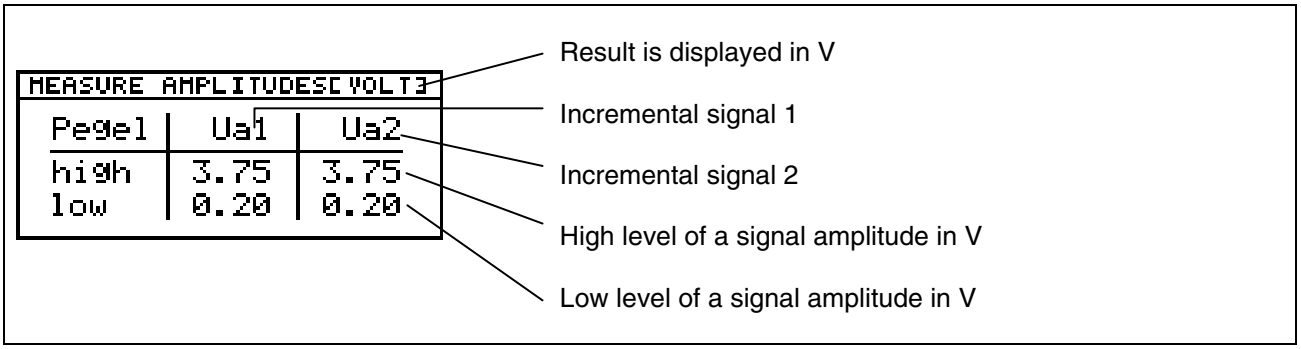
Calculation: $\left|\frac{\mathbf{a}-\mathbf{b}}{\mathbf{2}\times\mathbf{c}}\right|$ Result: ideal = 0

A / B: Amplitude ratio, amplitudes of incremental signals Ie1 versus Ie2

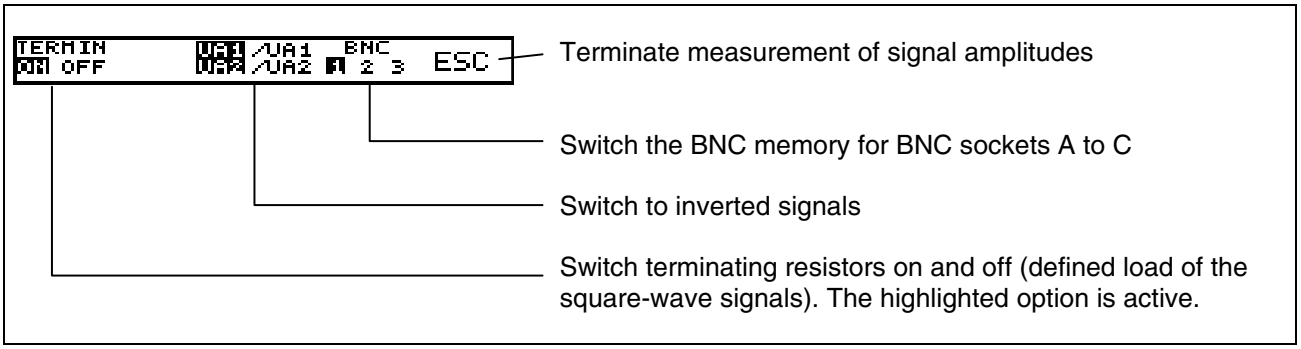
Calculation: $\frac{C_A}{C_B}$ Result: ideal = 1



4.5.3 Measuring the Signal Amplitudes with TTL or HTL Interface Boards



The following options are available in the corresponding soft-key row:



Special feature of HTL interface board:

Up to software version 05:

With HTL encoders the inverted signals may not be available depending on the encoder.
Check whether the inverted signals are available before measuring the signal amplitudes. PWM 8 cannot recognize, whether there are inverted signals or not!
If the inverted signals are missing, incorrect values are displayed for the signal amplitudes!

From software version 05:

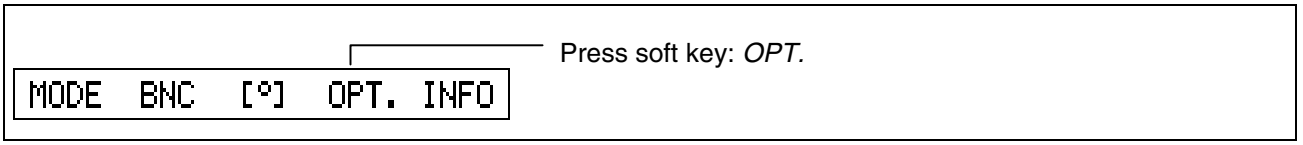
If the encoder does not provide inverted signals, "------" is displayed for the signal levels of the inverted signals.

5. EXPERT MODE

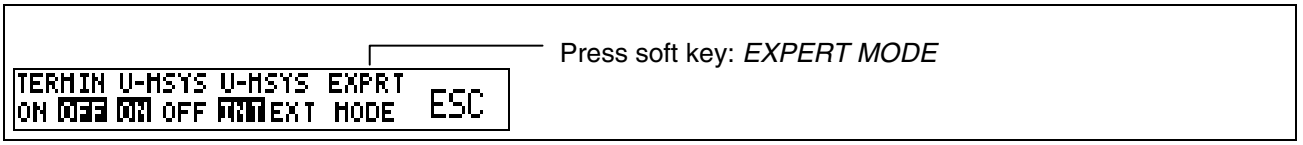
In addition to the standard functions PWM 8 offers further possibilities in the EXPERT MODE:
- Input of a PRESET
- Possibility of adjusting the encoder voltage
- Parameter programming

5.1 Activating the EXPERT MODE

The EXPERT MODE is activated by pressing the left and the right soft key while the power-on screen is displayed.
The message: EXPERT-MODE is displayed.
With parameter P4: SAVE EXPERT MODE the activation of the EXPERT MODE can be automated.
After the power-on screen the standard soft-key row is displayed:



After pressing the soft key OPT. (OPTIONS) in this soft-key row, the OPTIONS soft-key row is displayed.
From there you can switch to the EXPERT MODE.



When pressing the soft key EXPERT MODE, the following options are displayed.
Soft-key row of the EXPERT MODE:

5.2 Auxiliary Functions in the EXPERT MODE

U-MSYS <<<<

Reduce U-MSYS:
The power supply of the encoder can be reduced to approx. 3V
(HTL interface board: 10V).

U-MSYS >>>>

Increase U-MSYS:
The power supply of the encoder can be increased to approx. 6V (HTL interface board 19V when operating with an external 24V power supply unit).
See parameter P3: U-MSYS Limit

PRE- SET

Activating the PRESET editors:
In the PWM 8 MODE: UNIVERSAL COUNTER a PRESET can be entered.

PARA- METER

Activating PARAMETER programming
The PWM 8 can be configured by means of parameters.

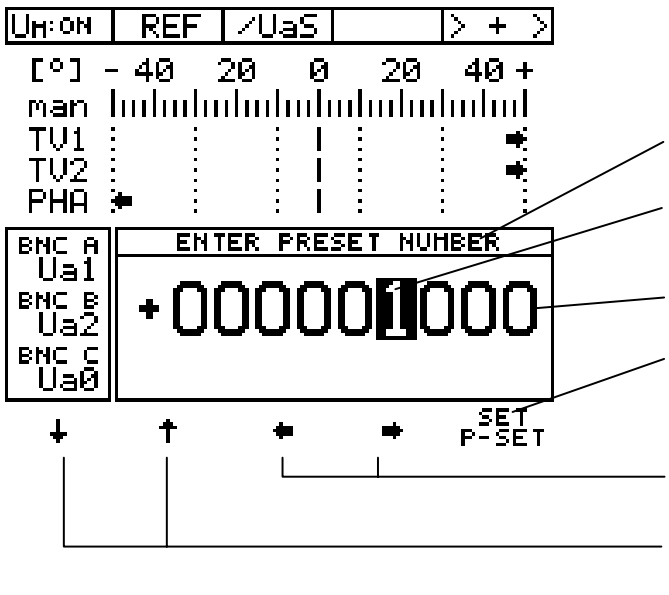
ESC

To terminate the EXPERT MODE press the soft key ESC.

5.2.1 The PRESET Editor

The UNIVERSAL COUNTER (PWM 8 MODE: UNIVERSAL COUNTER) can be loaded with a PRESET. In this case the UNIVERSAL COUNTER starts counting from this value.

After pressing the soft key: PRE-SET in the soft-key row of the EXPERT MODE the PRESET editor is activated.



PRESET editor

The highlighted figure can be edited.

Display field for the PRESET

By pressing the soft key *SET P-SET* the displayed PRESET is transferred into the UNIVERSAL COUNTER.

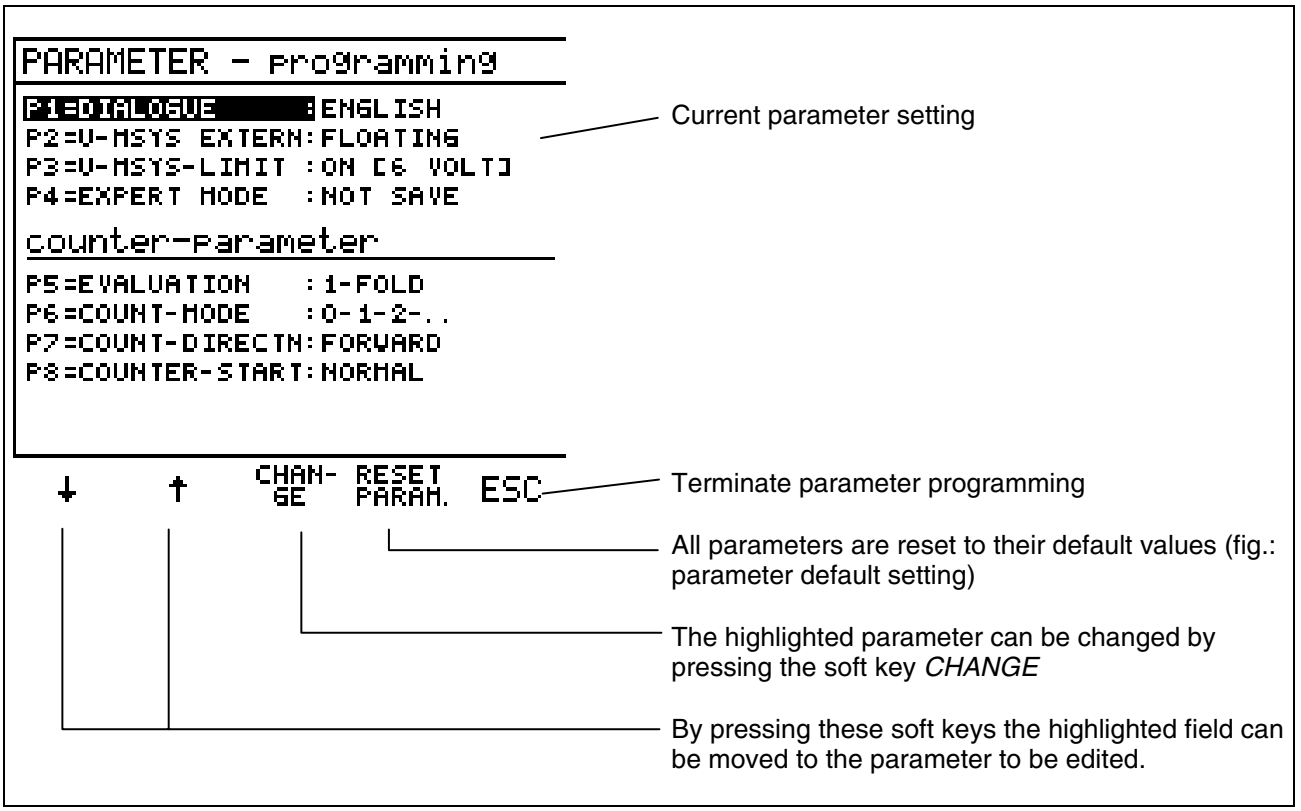
These soft keys serve to move the highlight to the figure (or to the sign) to be changed.

With these soft keys the highlighted figure (or the sign) can be edited.

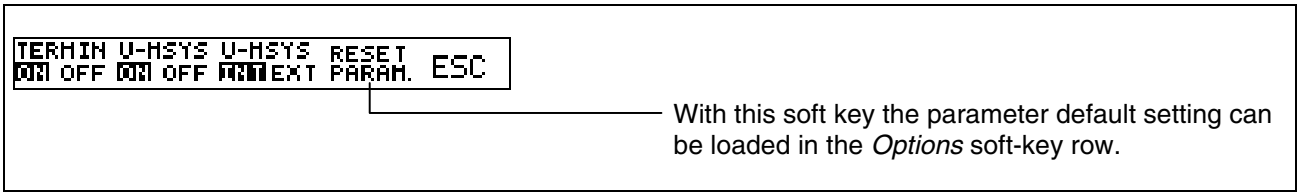
5.2.2 The Parameters

By means of parameter programming several PWM 8 settings can be changed.

After pressing the soft key [PARA-METER] in the soft-key row of the EXPERT MODE, the menu for parameter programming is displayed. When commissioning PWM 8 the parameter default setting is as follows:



If parameters are changed, PWM 8 internally stores the changes. When the PWM 8 is switched on again, the stored parameter values are loaded.
If parameter values have been stored that are different from the standard setting and the EXPERT MODE is not active, the standard setting can be loaded from the Options soft-key row.
However, the parameter P1 Dialogue is not changed.



5.2.3 Parameter Overview

Parameter P1: Dialogue Language

[GERMAN, ENGLISH] Software Id.No.: 246 199 xx
[GERMAN, FRENCH,] Software Id.No.: 246 200 xx

The dialogue of PWM 8 can be switched. Possible language combinations are German/English and German/French.

Parameter P2: U-MSYS EXTERN [FLOATING, FROM CUSTOMER]

Note: Parameter P2 is only effective, if the encoder is powered externally (= by a subsequent electronics, e.g. a counter, a control or customer electronics). In this case PWM 8 can be switched to EXTernal power supply of the encoder in the Options soft-key row:

Soft key to switch to EXTernal power supply of the enocder. This soft key is only displayed, if an encoder voltage of a subsequent electronics has been connected to the encoder output of the interface board.
Shown setting: encoder is powered externally.

If the encoder is powered EXTERNALLY, parameter 2 serves to choose whether the encoder supply of the subsequent electronics is to be

- floating with relation to PWM 8 (potential segregation) (parameter setting: FLOATING), or
- directly fed to the encoder without being changed by PWM 8 (parameter setting: FROM CUSTOMER).

Special feature of HTL interface board:
When using a HTL interface board, parameter P2 is not available. The measuring system can only be powered with the potential of the subsequent electronics. Potential segregation is not possible!

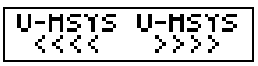
Why is potential segregation required between PWM 8 and subsequent electronics?

Owing to different reference potentials of the encoder signals 11µApp/1Vpp (U_0) and the interface boards (0V) the signals **may** be shifted, which can cause counting errors in the subsequent electronics and in the most unfavorable case result in a measuring circuit error. Potential segregation avoids signal shifts and ensures that the encoder circuit operates correctly, when PWM 8 is switched on.

Notes on floating encoder supply from the subsequent electronics:
(Parameter P2: FLOATING)

1. To ensure trouble-free functioning of subsequent electronics with 11µApp and 1Vpp encoder inputs.

2. In the PWM 8 the power supply of the encoder is generated by a switching regulator, providing 5.0V (standard setting) irrespective of the encoder power supply of the subsequent electronics. If required, the encoder voltage can be set manually.

   For this purpose the soft keys 

   in the soft-key row of the EXPERT MODE are available.

   Note on HTL interface boards:
   When using a HTL interface board the standard setting of the encoder voltage is 12V, if there is no supply voltage of the subsequent electronics at the OUT flange socket of the interface board. If there is a voltage, PWM 8 "connects" the HTL encoder voltage to the encoder voltage of the subsequent electronics. With HTL interface boards potential segregation is not possible.

3. The current intensity of the encoder voltage is set to 500 mA; if the terminating resistors (with TTL and HTL interface boards) are switched on, it is 700 mA.

4. Owing to potential segregation the power consumption of the encoder supply by the subsequent electronics is approx. 50% higher than it would be without potential segregation (due to the efficiency of the DC/DC converter and the switching regulator). Please also note the increased voltage drop on the encoder supply line caused by the higher current intensity!

Notes on encoder supply directly from the subsequent electronics:
(Parameter P2: FROM CUSTOMER)

1. Trouble-free functioning of subsequent electronics with 11µApp and 1Vpp encoder interfaces cannot be guaranteed due to signal shifts of the subsequent electronics!

2. The encoder voltage of the subsequent electronics is fed directly to the encoder without being changed by PWM 8; it cannot be altered.

3. There is no current limitation for the encoder voltage.

4. The power consumption of the subsequent electronics for the encoder supply is only slightly higher than that of the encoder. About 10 mA are required for the voltage monitor of the subsequent electronics.

Parameter P3: U-MSYS LIMIT [ON (6 VOLTS), OFF (9 VOLTS)]

Parameter P3 defines the maximum limits for the encoder voltage. By switching off the U-MSYS limit the encoder voltage can be set in the range of 9V ±1V.

Caution: The measured object may be destroyed by overvoltage!
Standard encoders are operated with a voltage of 5V ± 5%.

Special feature of HTL interface boards:
When using the HTL interface board, parameter P3 is not available!

In the EXPERT MODE the encoder voltage can only be set with the soft keys 

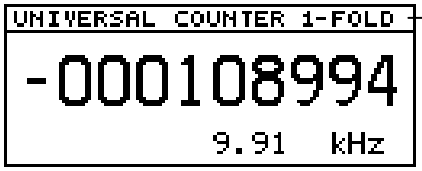
if the parameter P2 is set to FLOATING.

Parameter P4: EXPERT MODE [NOT SAVE, SAVE]

If parameter P4 is set to SAVE, the EXPERT MODE is reactivated after power interruption; if it is set to NOT SAVE, the EXPERT MODE must be reactivated each time power is switched on.

Parameter P5: EVALUATION [1-FOLD, 2-FOLD, 4-FOLD]

In parameter P5 the edge evaluation of the UNIVERSAL COUNTER (PWM 8 MODE UNIVERSAL COUNTER) is set. It defines how many edges per signal period of incremental signal 1 and incremental signal 2 are transferred to the UNIVERSAL COUNTER and used for measurement of the frequency.
In the PWM 8 MODE: DETERMINE PULSE NUMBER the evaluation is automatically set to 1-FOLD. The EVALUATION is displayed next to the headline of the UNIVERSAL COUNTER:



Display of edge evaluation of the universal counter (here: 1-FOLD)

Parameter P6: COUNTING MODE [0-1-2, 0-2-4, 0-5-0]

Parameter P6 defines the COUNTING MODE of the last digit of the UNIVERSAL COUNTER.

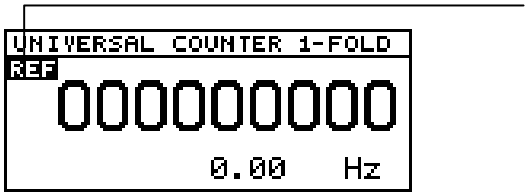
Parameter P7: COUNTING DIRECTION [FORWARD, BACKWARD]

P7: FORWARD = positive counting direction
P7: BACKWARD = negative counting direction

Parameter P8: COUNTER START [NORMAL, WITH REF]

P8: NORMAL
UNIVERSAL COUNTER starts immediately after selection.

P8: WITH REF
The UNIVERSAL COUNTER starts with the next reference signal. The current count is frozen until the first reference mark is reached. This "time-out" is marked by the symbol **REF** in the display field of the UNIVERSAL COUNTER.



Symbol for "timeout":
start with the next reference signal

6. Practical Application

6.1 Power Supply of PWM 8 and Encoder

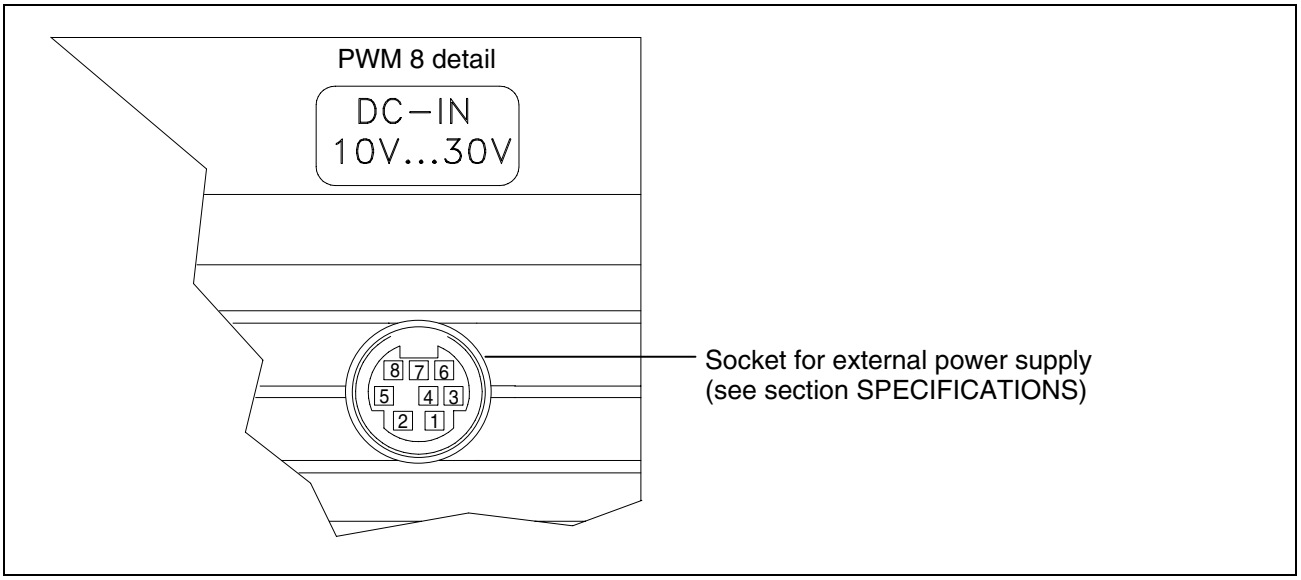
6.1.1 Power Supply of PWM 8 and Encoder via DC-IN Socket

In general PWM 8 and the encoder can be powered from different sources. The table below contains an overview of possible power supplies:

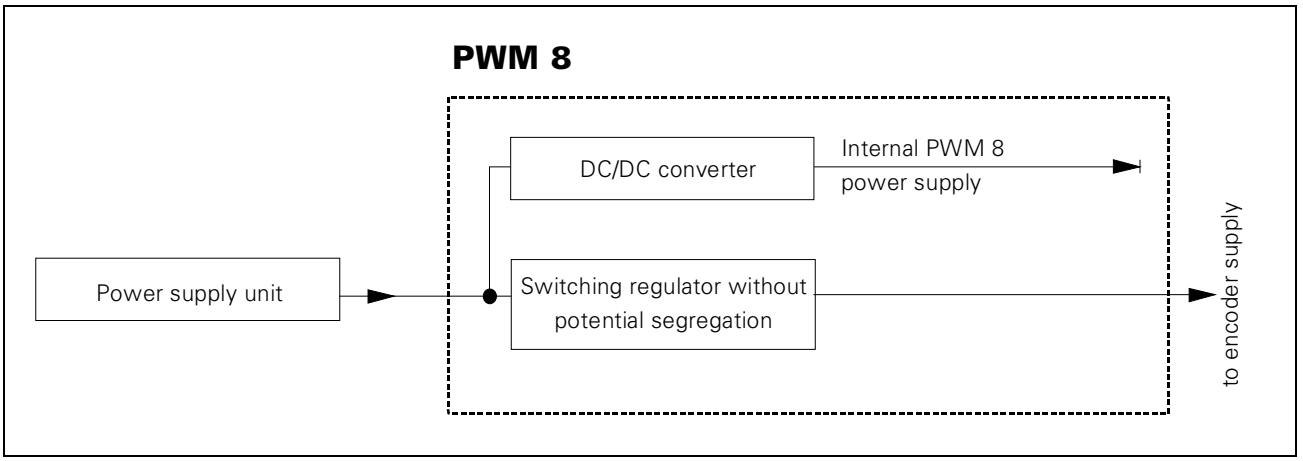
	PWM 8 powered from		Power supply of encoder	
	24 V power supply unit	**subsequent electronics**	**directly from subs. electronics**	**floating**
only 24V power supply unit connected (DC-IN socket)	x			x[1)]
only voltage from subsequent electronics connected (encoder output)		x	x	x[1)]
24 V power supply unit and voltage of subsequent electronics connected	x		x	x[1)]

[1)] When using a HTL interface board, potential segregation is not possible.

As already mentioned in section 2 "General Information", PWM 8 may either be powered by the 24V power supply unit (standard set) or another dc voltage source of 10 - 30 V via the DC-IN socket. The voltage at the DC-IN socket is referenced to the encoder voltage generated by PWM 8, i.e. if potential segregation is required between PWM 8 and subsequent electronics, the voltage at the DC-IN socket must be floating with relation to the subsequent electronics. The 24V power supply unit supplied with PWM 8 complies with this requirement.
If the PWM 8 is operated via the DC-IN socket, it is **always** powered from this current source, irrespective of whether an encoder voltage is fed at the encoder output of the interface board or not.



Basic circuit diagram of the power supply of the encoder with the power supply unit connected:



The standard setting of the encoder power supply is 5V; when operating with HTL interface board without subsequent electronics 12V.

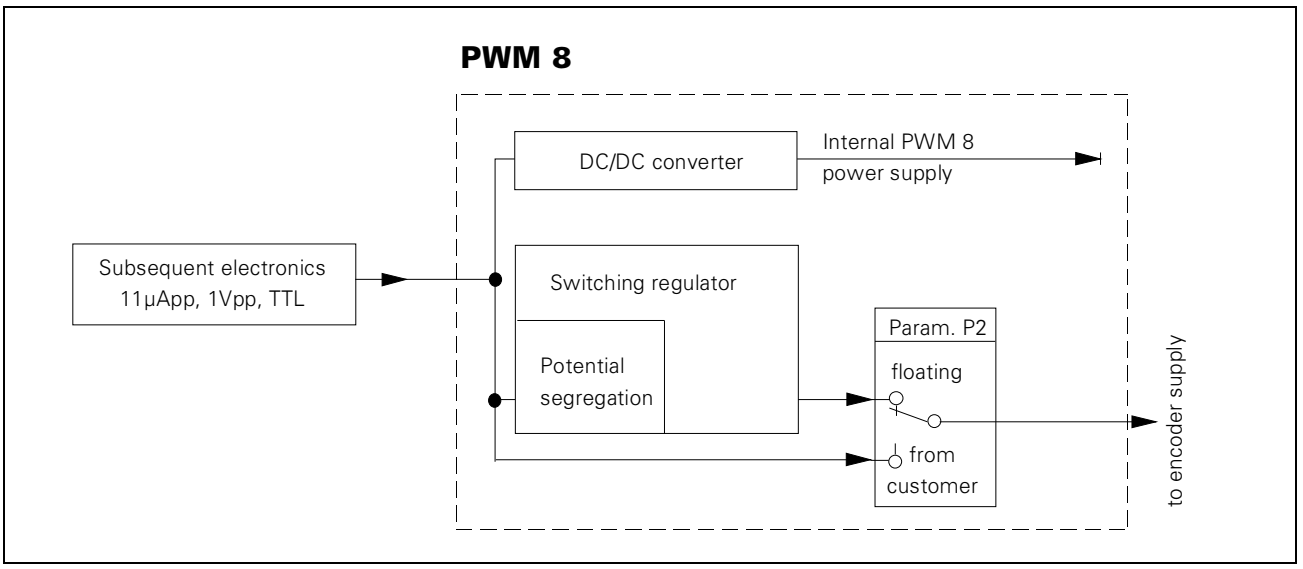
Current consumption of PWM 8 when powered via **DC-IN** socket:
(measured with 11µApp interface board)

Voltage at DC-IN	**10 V**	**12 V**	**15 V**	**20 V**	**24 V**	**30 V**
PWM 8 current consumption	500 mA	420 mA	350 mA	270 mA	230 mA	200 mA
PWM 8 current consumption with encoder (100 mA)	580 mA	480 mA	400 mA	310 mA	260 mA	220 mA

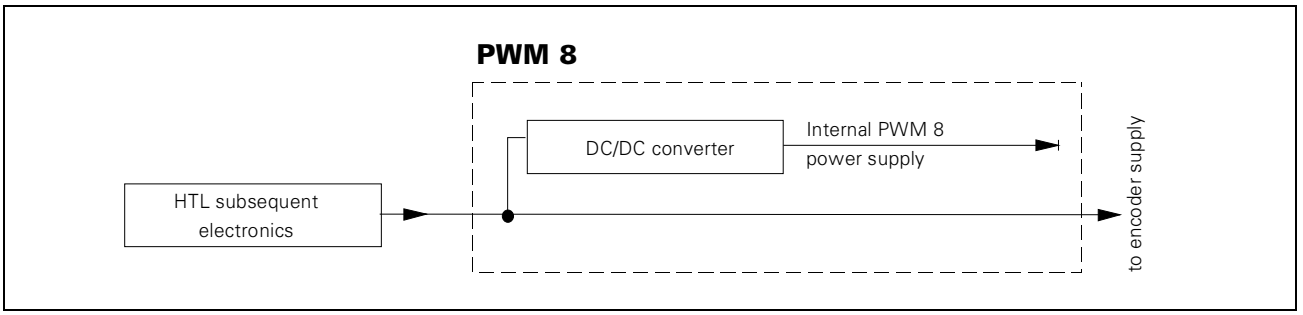
6.1.2 Power Supply of PWM 8 and Encoder via the Encoder Output (OUT) of the Interface Board

PWM 8 can be integrated into the encoder circuit. For this purpose the subsequent elec-tronics must be connected to the encoder output (OUT) of the interface board. The supply voltage for PWM 8 is taken from the subsequent electronics. In order to reduce the power consumption of the subsequent electronics, the background lighting of the display is auto-matically switched off!

Basic circuit diagram of the power supply of encoder and PWM 8 with subsequent electronics connected (with interface board 11µApp, 1Vpp, TTL):



Basic circuit diagram of the power supply of encoder and PWM 8 with subsequent electronics connected (with HTL interface board):



Current consumption of PWM 8 powered by **subsequent electronics**:
(measured with 11µApp interface board)

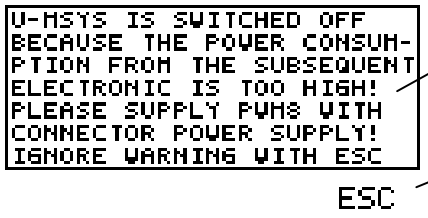
Supply voltage at interface board OUT	4.5 V	4.8 V	5 V	5.2V
PWM 8 current consumption (without background lighting)	1.15 A	1.05 A	1.0 A	0.95 A
PWM 8 current consumption with encoder (100 mA)	1.4 A	1.25 A	1.2 A	1.15 A

From the table can be seen that PWM 8 and encoder can only be powered by subsequent electronics equipped with power supply units with **large power reserve**.

Note:
When using (long) connecting cables between the subsequent electronics and PWM 8 the voltage drop may be considerable (current on the line to and from the encoder) which additionally reduces the voltage of the subsequent electronics!
In the PWM 8 MODE: MEASURE AMPLITUDES the current consumption from the subsequent electronics is **approx. 0.4 A higher**!

Note:
If parameter P2: U-MSYS EXTERN is set to FLOATING, potential segregation and the switching regulator in PWM 8 can be switched off by setting P2 to FROM CUSTOMER. This reduces the power consumption from the subsequent electronics (see section 5.2.2, PARAMETERS, Parameter P2).
When using the HTL interface board, parameter P2 is not available and potential segregation not possible!

Voltage monitoring function of PWM 8 power supply:
If the voltage of the subsequent electronics falls below 4.8V, a warning is displayed:



Warning: The voltage of the subsequent electronics is too low to power PWM 8! The encoder supply was switched off to be on the safe side.

Press this soft key to ignore the warning.

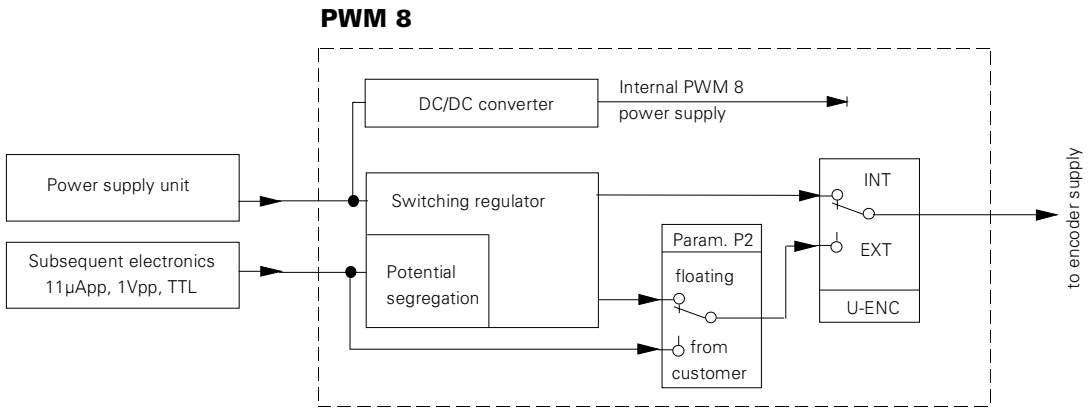
When this warning appears, we recommend to power PWM 8 via the power supply unit.
The warning can be ignored, if desired. It is then no longer displayed (however a warning is displayed in the INFO MODE). After power interruption the voltage monitor is reactivated.
To be on the safe side, the encoder supply is switched off.
The operator must reactivate it in the OPTIONS soft-key row. Afterwards, trouble-free functioning of PWM 8 can no longer be guaranteed and must be observed by the operator

6.1.3 PWM 8 Power Supply via DC-IN Socket and Encoder Output (OUT) of the Interface Board

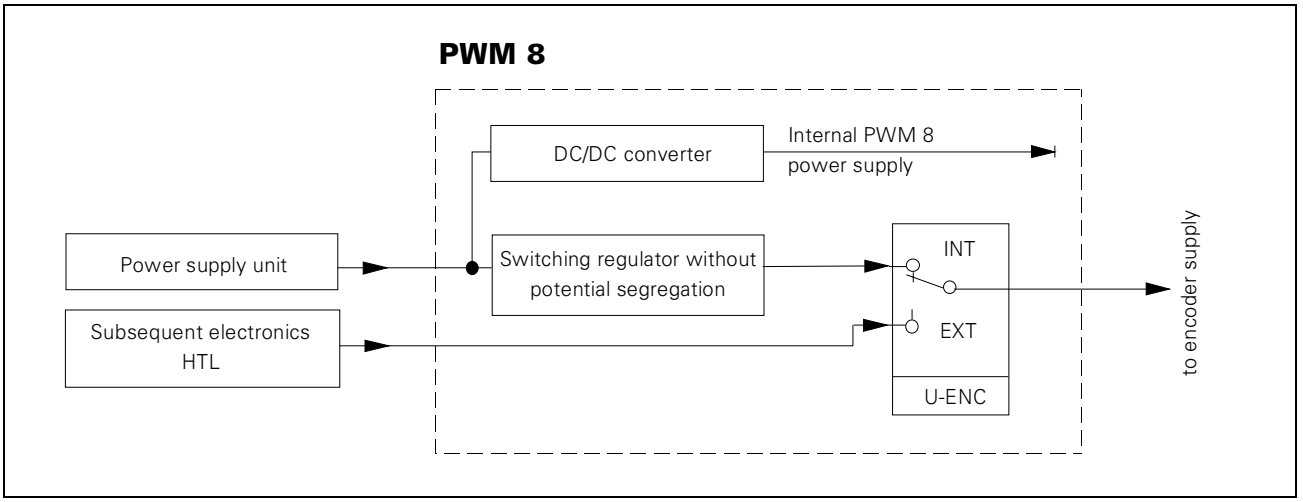
If the 24V power supply unit and the subsequent electronics are simultaneously connected, PWM 8 is always powered by the 24V power supply unit. In the OPTIONS soft-key row the power supply of the encoder can be selected:

The encoder can be powered *INTernally* (by the 24V power supply unit) or *EXTernally* (by the subsequent electronics) (current setting: *INTernally*)

Basic circuit diagram of power supply of encoder and PWM 8 with 24V power supply unit and subsequent electronics connected (with interface board 11µApp, 1Vpp, TTL):



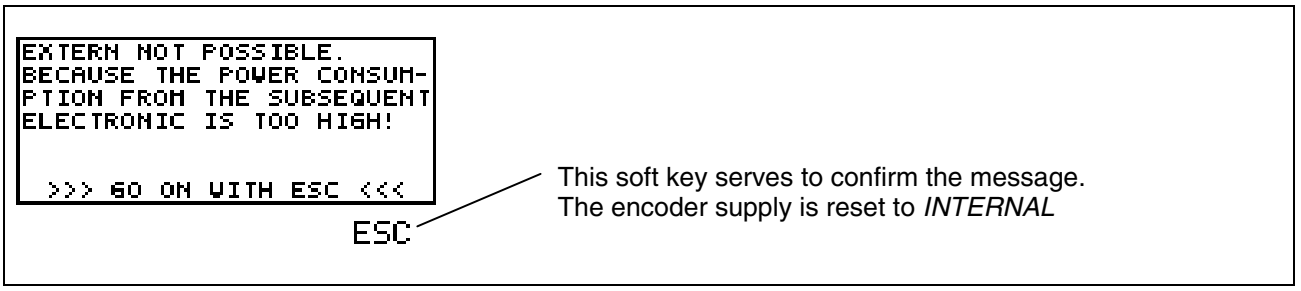
Basic circuit diagram of power supply of encoder and PWM 8 with 24V power supply unit and subsequent electronics connected (HTL with interface board):



Note on HTL interface boards:
If the encoder voltage of the HTL interface board is set to INTERNAL and at the same time a subsequent electronics connected to the OUT flange socket of the interface board, the switching regulator in PWM 8 tries to set (clamp) the encoder voltage to that of the subsequent electronics. PWM 8 is not permanently adjusted to the encoder voltage of the subsequent electronics; it is only adjusted when the PWM 8 is switched on, when the encoder voltage is switched on or off or the encoder supply is set to INTERNAL. If there is no subsequent electronics connected, the switching regulator provides 12V in the standard setting. With the HTL interface board potential segregation of voltage, subsequent electronics and encoder voltage is not possible.

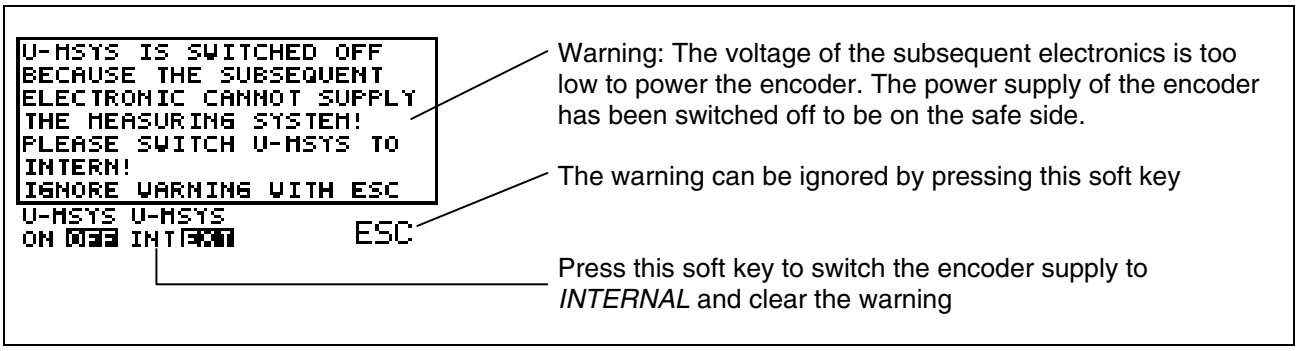
6.1.4 Voltage Monitoring Function of Encoder Supply

If the encoder supply is set to EXTERNAL and parameter P2 U-MSYS EXTERN set to FLOATING, PWM 8 checks the voltage of the subsequent electronics. In order to switch the encoder voltage to EXTERNAL the subsequent electronics must at least provide the power-on current for potential segregation and for the switching regulator. If this is not the case, the following message is displayed:



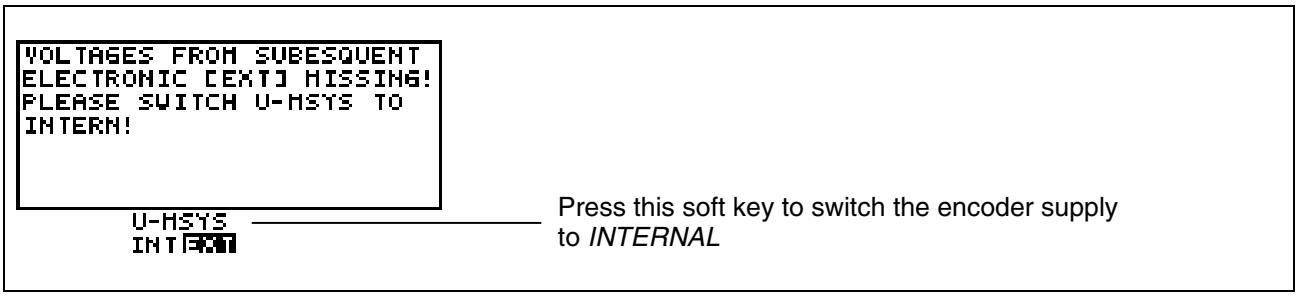
Note:
If parameter P2 U-MSYS EXTERN is set to FLOATING, the potential segregation and the switching regulator in PWM 8 can be switched off by setting P2 to FROM CUSTOMER.
This reduces the power consumption from the subsequent electronics (see section 5.2.2 PARAMETERS, Parameter P2).
When using the HTL interface board, parameter P2 is not available. Potential segregation is not possible in this case.

If in the OPTIONS soft-key row the encoder supply is set to EXTERNAL and parameter P2 U-MSYS EXTERN to FLOATING, PWM 8 checks the voltage of the subsequent electronics. If the voltage drops to approx. 4.5V trouble-free functioning of potential segregation and switching regulator can no longer be guaranteed; a warning is displayed:

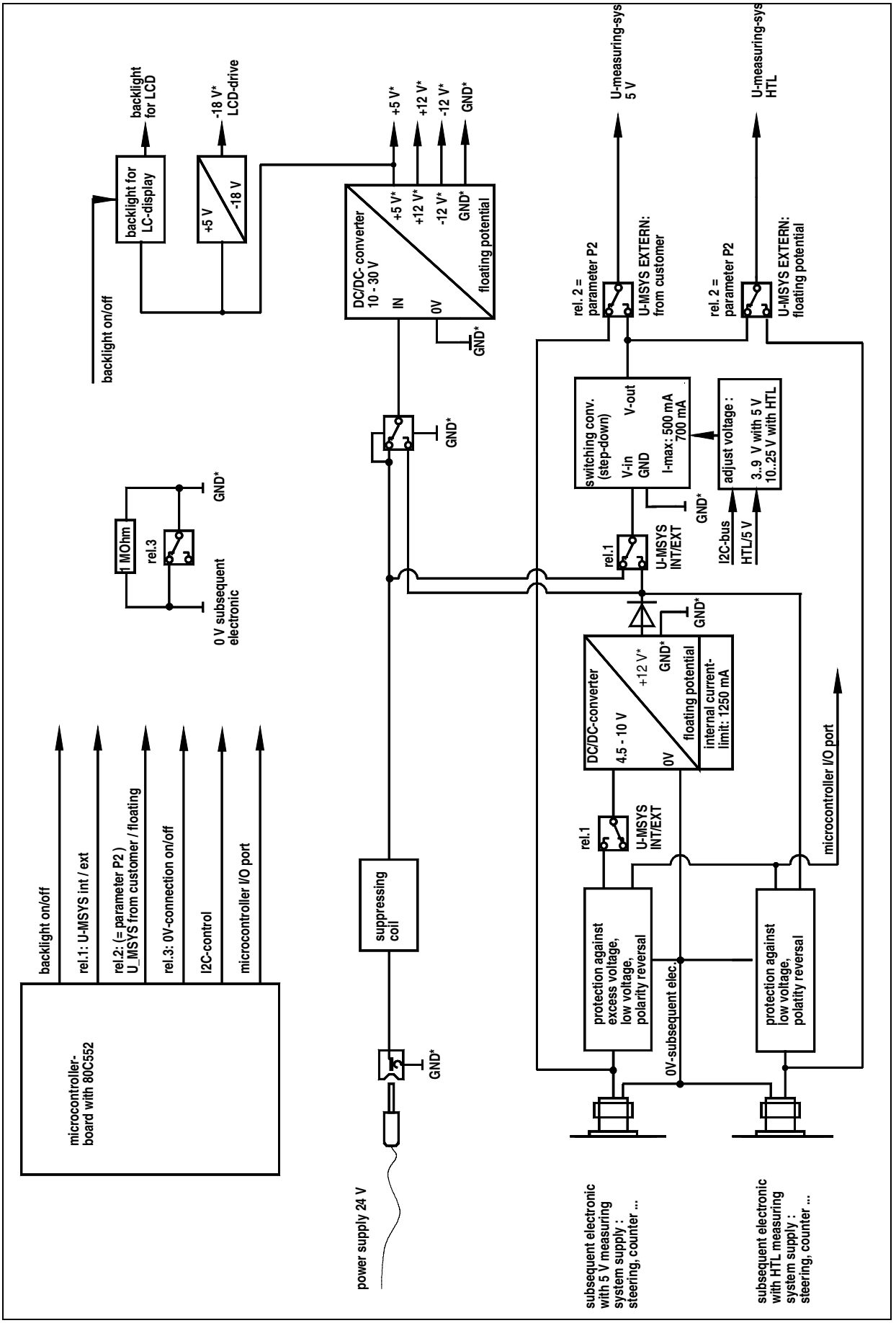


When this warning is displayed, the encoder supply must be switched to INTERNAL. The warning can be ignored, if desired.
In this case the warning is no longer displayed. (However a warning is displayed in the INFO MODE). To be on the safe side, the encoder supply is switched off. The operator must reactivate it in the OPTIONS soft-key row. Afterwards, trouble-free functioning of PWM 8 can no longer be guaranteed and must be observed by the operator.

If the voltage of the subsequent electronics falls below 3V, another warning is displayed requesting the operator to switch the encoder supply to INTERNAL:



6.1.5 Block Diagram: PWM 8 Power Supply Unit



7. Calibration

In general no maintenance is required for PWM, since there are no components that are subject to wear. However, to ensure reliable and trouble-free operation we recommend to send your PWM 8 including the interface boards (especially 11µApp and 1Vpp) every 2 years to HEIDENHAIN, Traunreut for calibration.

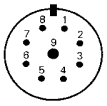
Note:
Calibration of the PWM always includes a software upgrade!

8. Specifications

8.1 Pin Layouts of the Interface Boards

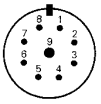
8.1.1 Pin Layout of the 11µApp Interface Board

9-pin HEIDENHAIN flange socket
at IN flange socket of interface board



1	2	5	6	7	8	3	4	9
I_1		I_2		I_0		5 V	0 V	0 V
+	–	+	–	+	–	U_P	U_N	internal shield

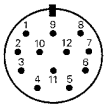
9-pin HEIDENHAIN flange socket
at OUT flange socket of interface board



1	2	5	6	7	8	3	4	9
I_1		I_2		I_0		5 V	0 V	free
+	–	+	–	+	–	U_P	U_N	

8.1.2 Pin Layout of the 1Vpp Interface Board

12-pin HEIDENHAIN flange socket
at IN flange socket of the interface board
at OUT flange socket of the interface board

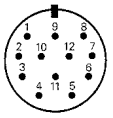


5	6	8	1	3	4	12	10	2	11	9	7
A		B		R		5 V	0 V	5 V	0 V	free	free
+	–	+	–	+	–	U_P	U_N	sensor	sensor		

The sensor lines are connected to the corresponding supply lines
(exception: PWM 8 MODE: MEASURE U/I).

8.1.3 Pin Layout of the TTL Interface Board

12-pin HEIDENHAIN flange socket
at IN flange socket of the interface board
at OUT flange socket of the interface board

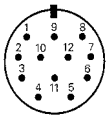


1	2	3	4	5	6	7	8	9	10	12	11
$\overline{Ua2}$	+5 V sensor	Ua0	$\overline{Ua0}$	Ua1	$\overline{Ua1}$	$\overline{UaS}$	Ua2	chassis	0 V U_N	+5 V U_P	0 V sensor

The sensor lines are connected to the corresponding supply lines
(exception: PWM 8 MODE: MEASURE U/I).

8.1.4 Pin Layout of the HTL Interface Board

12-pin HEIDENHAIN flange socket
at IN flange socket of the interface board
at OUT flange socket of the interface board



1	2	3	4	5	6	7	8	9	10	12	11
$\overline{Ua2}$	10-30 V sensor	Ua0	$\overline{Ua0}$	Ua1	$\overline{Ua1}$	$\overline{UaS}$	Ua2	chassis	0 V U_N	10-30 V U_P	0 V sensor

The sensor lines are connected to the corresponding supply lines
(exception: PWM 8 MODE: MEASURE U/I).

8.2 Pin Layout of the Power Supply Socket on PWM 8

8-pin power supply socket DC-IN

1	2	3	4	5	6	7	8
10-30V				0V			

8.3 Specifications of PWM 8 Base Unit

Power supply PWM 8:

- *at DC-IN socket*:

Power supply:	10 - 30 V
Current consumption of PWM 8 without encoder:	approx. 230 mA (5.5 W) with 24 V power-on current approx. 1 A
Current consumption with power supply unit:	approx. 15 W

- *at OUT flange socket of the interface board*:

Power supply:	3 - 10 V (11µApp, 1Vpp, TTL) 10 - 30 V (HTL)
Current consumption of PWM 8 without encoder:	approx. 1.0 A (5 W) with 5 V

Power supply of the encoder by PWM 8:
Note: Parameter P2: U-MSYS EXTERN set to FLOATING

Encoder voltage (11µApp, ¸1Vpp, TTL)	3 - 9 V selectable standard setting: 5 V ± 0´.1 V
Encoder voltage (HTL) (without voltage of subsequent electronics)	10 - 19 V with 24 V power supply unit 10 - 25 V with 30 V at DC-IN standard setting: 12 V ± 0.2 V
Encoder voltage (HTL) („clamp“ to voltage of subsequent electronics)	10 - 19 V with 24 V power supply unit tolerance ± 0.5 V
Encoder current	500 mA max.
Encoder current with termin. resistor switched on:	700 mA max.

Frequency display:

Measuring range of the frequency counter:	20 Hz - 2 MHz

Frequency range of the universal counter:

Maximum input frequency	approx. 2 MHz

Bar display PHA, TV1, TV2:

Measuring ranges in degrees [°]:	5, 10, 20, 50, autom. measuring range standard setting: ±50°	
Frequency range:	10 Hz - 10 MHz	
Error PHA/TV display:	10 Hz - 10 kHz	± 0.5 degrees
(for interface board TTL, HTL)	10 kHz - 500 kHz	± 2 degrees
	500 kHz - 1 MHz	± 3 degrees
Error PHA/TV display:	10 Hz - 10 kHz	± 1 degree
(for interface board 11µApp, 1Vpp)	10 kHz - 500 kHz	± 2.5 degrees
(Note: The offset adjustment of the trigger on the interface board must have been carried out!)	500 kHz - 1 MHz	± 3.5 degrees

Temperature range:	
Operating temperature	0 °C - + 40 °C
Storage temperature	- 20 °C - +60 °C

8.4 Specifications of 11µApp Interface Board

Signal amplification (Ie1, Ie2, Ie0): 300 $\frac{mV}{\mu A}$

Input amplifier:
Maximum signal current: Ie0, Ie1, Ie2: 66 µApp

Maximum frequency at encoder input:
-3 dB: approx. 300 kHz

Note:
The maximum input frequency only stands for the cutoff frequency of current/voltage converter in PWM 8 (signal source: frequency generator). In real operation with encoders the frequency highly depends on the photocells and their capacitance, as well as on the cable lengths.

Measure current/voltage:
Measuring range current: 0 - 500 mA
Measuring range voltage: 0 - 10 V
Tolerance: ± 3 %

Measure amplitudes:
Measuring range: 2 µApp - 33.3 µApp (0.6 - 10 Vpp)
Measuring frequency: 10 Hz - 50 kHz
Tolerance:
without adjustment via software: ± 5 %
with adjustment via software: ± 3 %

Fault detection signal: Ie1 and Ie2 < 4 µApp

Encoder output:
Output signal: like input signal **without** U_0

8.5 Specifications of 1Vpp Interface Board

Input amplifier:
Maximum signal voltage: ± 5 Vpp

Maximum frequency at encoder input:
for encoder voltage on interface board: approx. 500 kHz
for signals on BNC sockets (- 3dB): approx. 1 MHz

Note:
Input frequencies over 1 MHz are possible; however, the tolerance of the PHA/TV display can no longer be guaranteed!
The maximum input frequency only stands for the cutoff frequency of the voltage input of PWM 8 (signal source: frequency generator). In real operation with encoders the frequency highly depends on the encoder and on the cable lengths.

Measure current/voltage
Measuring range current: 0 - 500 mA
Measuring range voltage: 0 - 10 V
Tolerance: ± 3 %

Measure amplitudes:

Measuring range:	0.2 Vpp - 1.6 Vpp
Measuring frequency:	10 Hz - 50 kHz
Tolerance:	
without adjustment via software:	± 5 %
with adjustment via software:	± 3 %

Terminating resistance: 121 Ω

Fault detection signal: A and B < 0.3 Vpp

Encoder output:

Output signal:	like input signal **with** U0

8.6 Specifications of TTL Interface Board

Maximum input voltage: ± 7V
Maximum input frequency: approx. 2 MHz

Note:
The maximum input frequency only stands for the cutoff frequency of the square-wave input at PWM 8 (signal source: frequency generator).

Measure current/voltage:

Measuring range	current:	0 - 500 mA
Measuring range	voltage:	0 - 10 V
Tolerance:		± 3 %

Measure amplitudes:

Measuring range	high level:	2.5 - 7.5 V
Measuring range	low level:	0 - 2.5 V
Resolution:		50 mV
Measuring frequency:		10 Hz - 200 kHz
Tolerance:		± 50 mV

Terminating resistance:

From encoder signal to U-MSYS	215 Ω
From encoder signal to GND	90,9 Ω

Special feature of TTL interface board:
Owing to the input wiring, the PHA/TV display works properly even in the case of a cable break. The missing signals are generated internally and output at the encoder output. Cable breaks can be found in the mode "Measure Signal Amplitudes" or by checking the encoder signals at the BNC sockets.

8.7 Specifications of HTL Interface Board

Maximum input voltage:	0 - 30 V
Maximum input frequency:	approx. 2 MHz

Note:
The maximum input frequency only stands for the cutoff frequency of the square-wave input at PWM 8 (signal source: frequency generator).

Measure U/I:

Measuring range	current:	0 - 500 mA
Measuring range	voltage:	0 - 30 V
Tolerance:		± 5 %

Measure amplitudes:

Measuring range	high level:	17.5 - 22.5 V
Measuring range	low level:	0 - 7.5 V
Resolution:		100 mV
Measuring frequency:		10 Hz - 200 kHz
Tolerance:		± 100 mV

Terminating resistance:

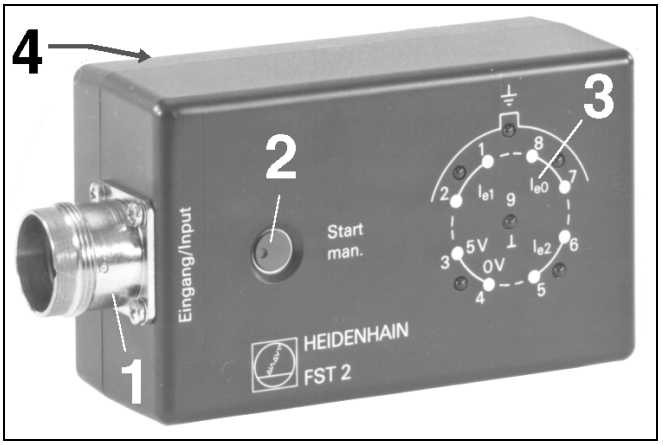
From encoder signal to U-MSYS	1200 Ω
From encoder signal to GND	1200 Ω

Special feature of HTL interface board:
If the inverted are missing at the encoder output, they are generated internally and output at the encoder output.

8.8 Specifications of Power Supply Unit

Input voltage:	100 - 240 V ac, 50 - 60 Hz
Output voltage:	24 V dc, 1.0 A
Protection grade:	1
Maximum ambient temperature:	40 °C

9. Description of FST 2 Leak Tester



The leak tester serves to check NC-linear encoders and rotary encoders with sinusoidal output signals and 9-pin connector for leak circuits (up to 3 MΩ) at the cabling and the photocell board.
The FST2 is switched on automatically as soon as a test piece (e.g. a linear encoder) is connected. The current conduction through the lamp (LED) of the encoder is used for testing. When testing equipment without a lamp (e.g. an extension cable or if the lamp is defective) the automatic test is not active. In this case the button "Start man." must be pressed.
Encoders with integral pre-amplifiers can only be tested for leak circuits between internal shield (⊥) and external shield(⏚).
Owing to the internal resistance of the pre-amplifier (< 3 MΩ) the remaining 4 LEDs always indicate a leak circuit when a test unit is connected.

9.1 Explanation of the Controls and Displays

1 Input socket, 9-pin:
For connection of measuring systems with sinusoidal output signals and extension cables with 9-pin connector.

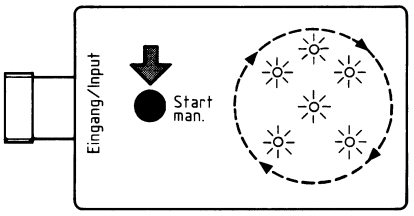
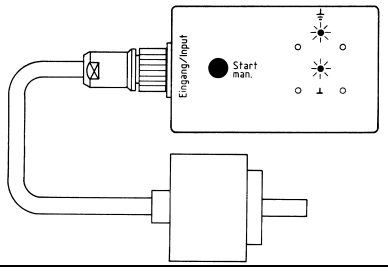
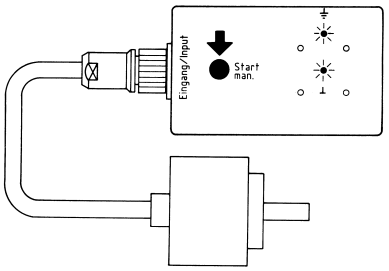
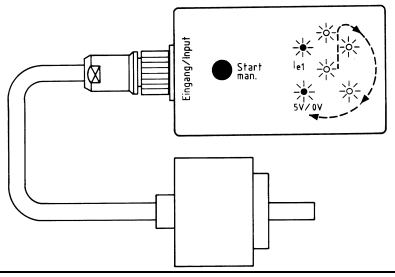
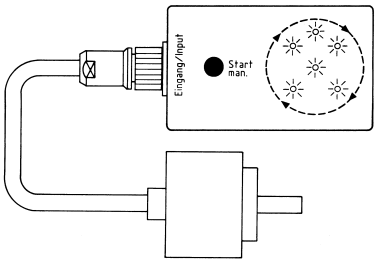
2 Manual start button:
When testing equipment without lamp/LED or encoders with defective lamp/LED the manual start button must be pressed to activate the FST2. The leak tester is then active as long as the button is pressed.
The manual start button also serves to test the battery. The battery voltage is in order,
if the LEDs light up in a sequence like a running light as long as the button is pressed.

3 LED display:
Leak circuits are displayed by permanently lit LEDs. The LED running light indicates that there is no leak circuit in the test piece.
The figure on the FST2 housing indicates the location of the leak circuits.

4 Brief operating instructions
Brief operating instructions in German are printed on the rear side of the leak tester.
A sticker in English language is supplied with FST2.

9.2 Example for Application

Testing a rotary encoder showing the following defects (leak circuits):
1. leak circuit between ⊥ and ⏚
2. leak circuit between Ie1 and 0V/5V

Instruction	Display	Error Cause
Battery test: press manual start button		Running light = battery o.k. LEDs dark = battery defective
Connect rotary encoder; test starts automatically!		Leak circuit is displayed between ⊥ and ⏚ (1. leak circuit).
Test is not started. (LEDs dark) Press manual start button; test is started.		Light unit of the rotary encoder defective or connection to light unit interrupted. Leak circuit is displayed between ⊥ and ⏚ (1. leak circuit)
Eliminate leak circuit in rotary encoder!		
Connect rotary encoder; test starts automatically.		The running light stops at the "0V/5V" LED. The leak circuit between 0V/5V and Ie1 is indicated by the LEDs 0V/5V and Ie1 permanently lit. (2. leak circuit)
Eliminate 2. leak circuit in rotary encoder!		
Connect rotary encoder; test starts automatically.		Each of the 6 LEDs lights up for a moment (running light) as long as the rotary encoder is connected or the manual start button pressed. **No leak circuit in the rotary encoder!**

After repair the test must be repeated until all LEDs light up like a running light.
Then there is no leak circuit in the test piece!

9.3 Specifications of FST 2

Sensitivity:
leak circuits ≤ 3MΩ

Test sequence
1. ⊥
2. ⏚
3. Ie0
4. Ie2
5. 0V/5V
6. Ie1

Test cycle
1 second

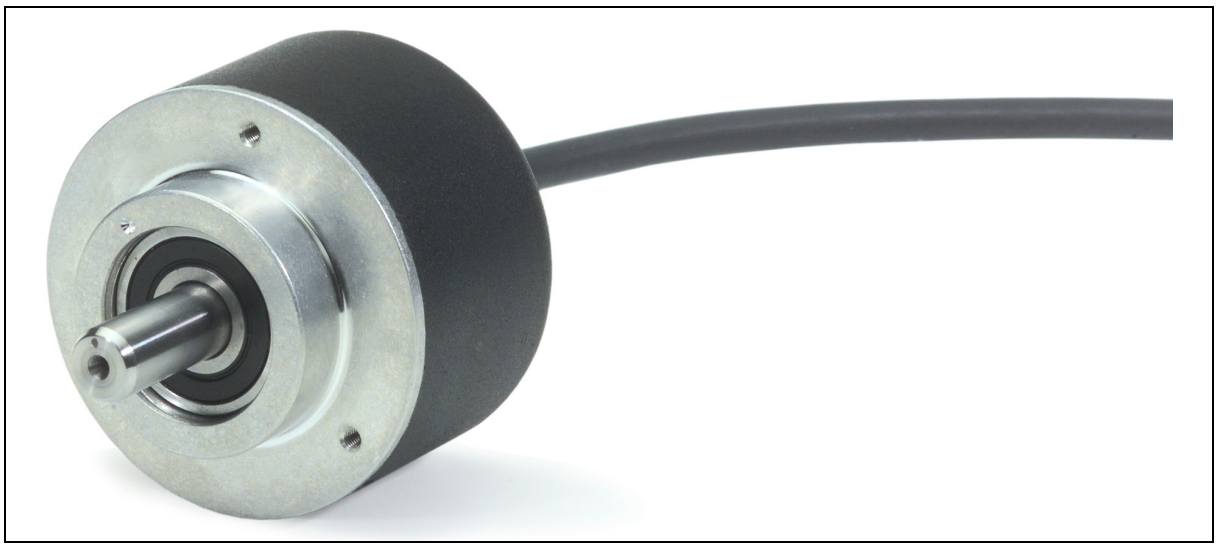
Power supply
9 V monobloc battery
Exchange the batteries every 2 years;
use leak-proof trademarked batteries (e. g. Alkaline)

Battery voltage
≥ 5.5 V
Below 5.5 V the tester is inoperative!

Current consumption
10 mA (in operation)
≤ 0.1 µA (quiescent current)

Cable lengths (depend on capacitance)

10. Description of ROD 450 Rotary Encoder



The ROD 450 serves to test counting function and interpolation of ND, VRZ, IBV EXE etc.
Moreover, it is suited to preset the oscilloscope trigger for checking the reference mark with PWM 8.

10.1 Specifications of ROD 450

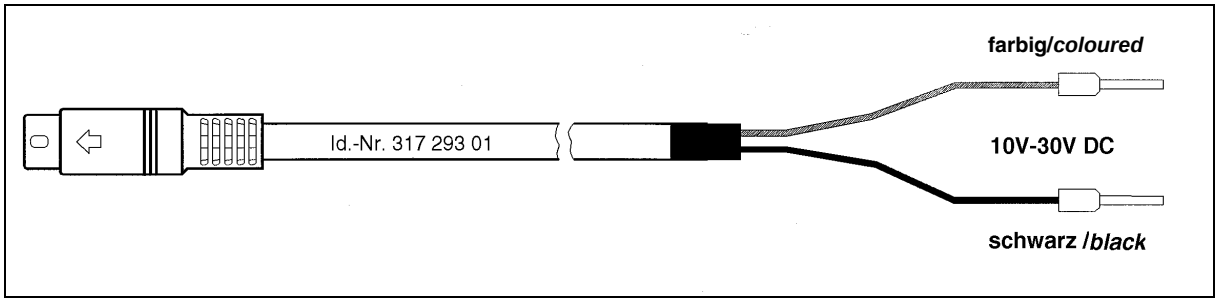
Power supply
5V ± 5%/85 mA

Output signals
Incremental signals Ie1 / Ie2
7 ... 16µApp
Reference signal Ie0
2 ... 8 µA (usable component)

Line count
1000 lines/revolution
1 ref. signal/ revolution

Cable length
1m

11. Description of Connecting Cable 10-30V DC

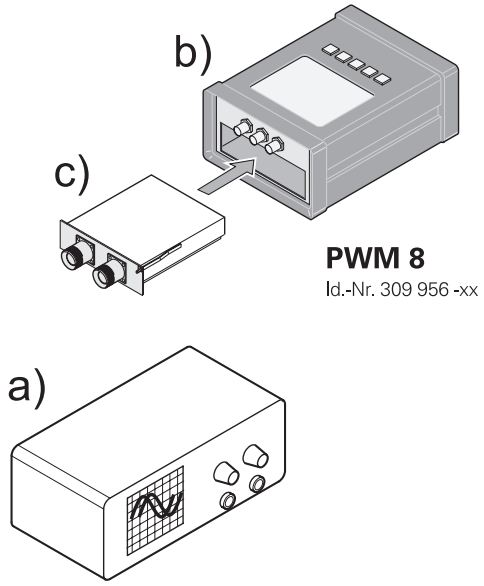


The connecting cable serves to power the PWM externally with 24V dc (e.g. control voltage of the machine tool).

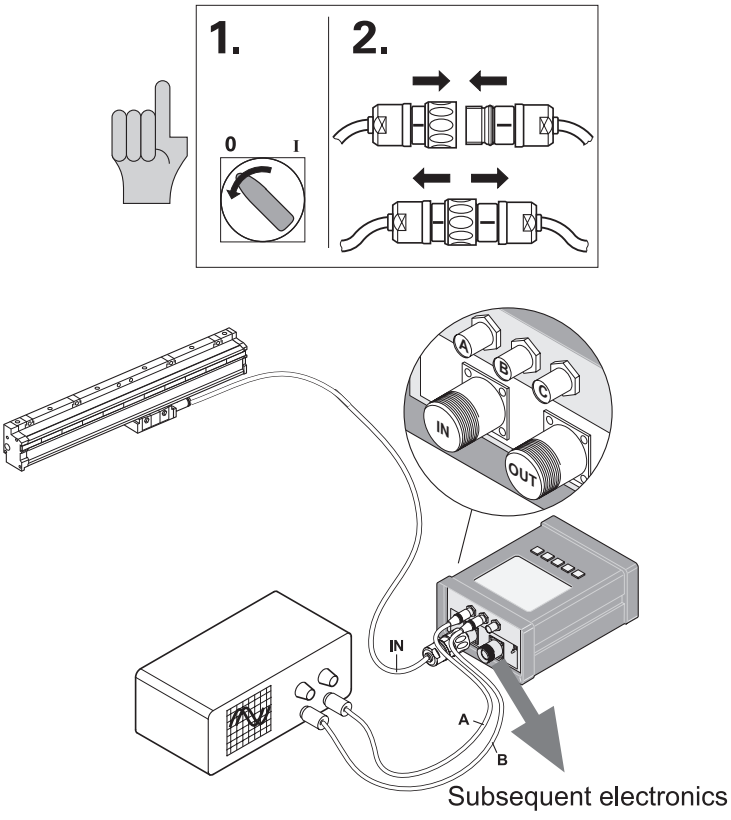
Note: The potential of the control voltage must be separated from the encoder voltage. measuring circuit error may occur without potential segregation.

12. Measuring Setup and Tolerances of the Output Signal

Example: Checking sinusoidal output signals



Equipment required for adjustment:
a) Oscilloscope (2 channels)
b) PWM 8
c) Interface board for 11 µApp or 1 Vpp



Connection of a linear encoder to an oscillloscope via PWM 8

Analog Output signals (~ 11 µApp/1 Vpp)

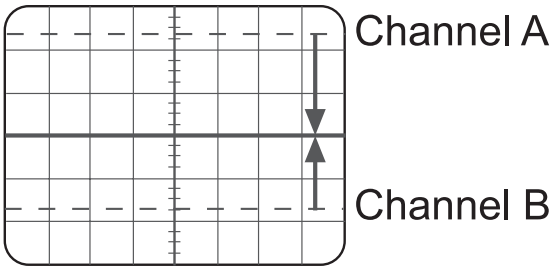
Prepare the oscilloscope as described below:

- **Vertical deflection**
  - Switch channels A and B to chop mode (CHOP).
  - Set the deflection coefficient (Sensitivity) of the channels A and B to 0.5 V/DIV (11µApp), 0.2 V/DIV (1Vpp).

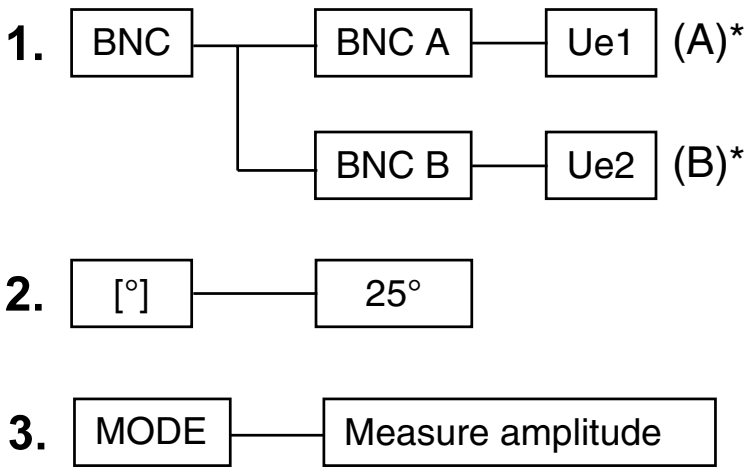
- **Horizontal deflection**
  - Set time coefficient (Time basis) to 0.5 ms/DIV.

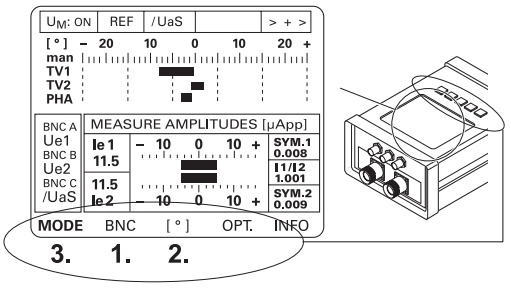
- **Triggering**
  - Trigger automatically (AUTO)
  - Trigger Channel A
  - Trigger positive edge

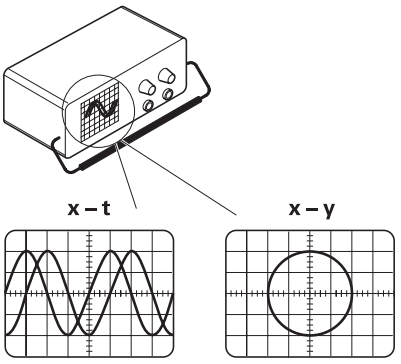
- **Calibration**
  - Switch the input coupling switch (AC/DC/GND) of the channels A and B to GND (⊥ or 0)
  - Use the Y-position potentiometers of the channels A and B to shift the electron rays congruently to the center of the screen (fig.)
  - Switch the input coupling switch (AC/DC/GND) of the channels A and B to DC .



PWM 8 Settings analog signals

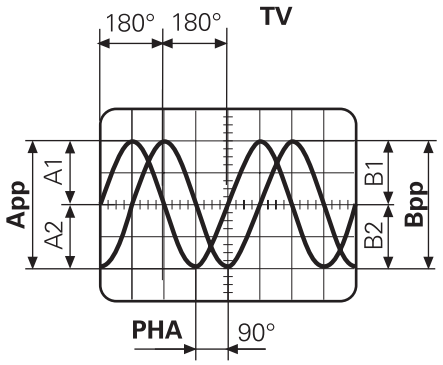


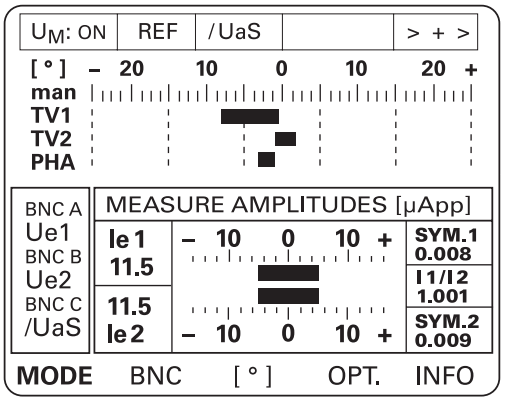




Possible oscilloscope display x - t or x - y

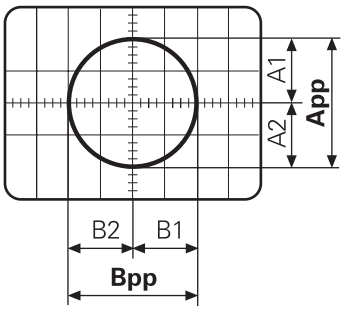
11 µApp-Interface		1 Vpp-Interface	
I_{e1}, I_{e2}	7 ... 16 µApp *	App, Bpp	0.6 ... 1.2 Vpp
$\frac{I_1}{I_2}$	0.8 ... 1.25	$\frac{A}{B}$	0.8 ... 1.25
PHA	90° ± 10°	PHA	± 10°
TV1, TV2	± 15°	TV1, TV2	± 15°
SYM.1	< 0.065	SYM.A	$\frac{\lvert A1 - A2 \rvert}{2\ App} < 0.065$
SYM.2	< 0.065	SYM.B	$\frac{\lvert B1 - B2 \rvert}{2\ Bpp} < 0.065$





* Old LS series:
LS 50x ; LS 80x
(z.B. LS 503, LS 803)

Ie1, Ie2 15 ... 35 µApp

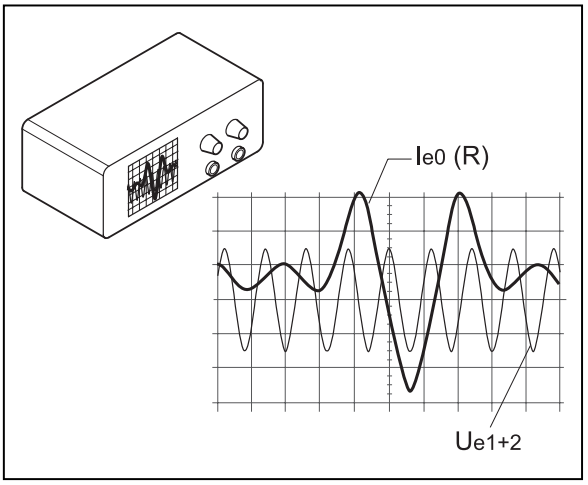


Reference mark signal
Oscilloscope display x - t

- Change the trigger setting of the oscilloscope basic setting as follows:
  - **Trigger channel A**
  - **Manual triggering** (AC or DC)
  - Trigger **negative edge**

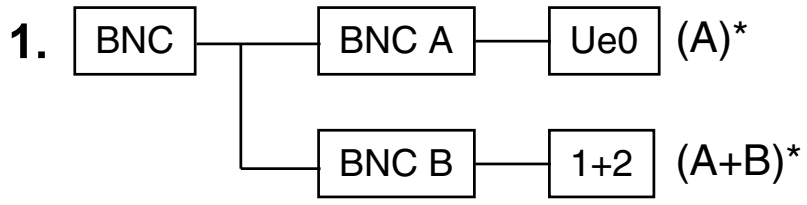
- Traverse the reference mark to be checked oscillatorily (“forward“/“backward“).

- At the oscilloscope turn the trigger potentiometer to set the trigger threshold (LEVEL) such that the reference mark signal is depicted as “stationary“ image on the screen.

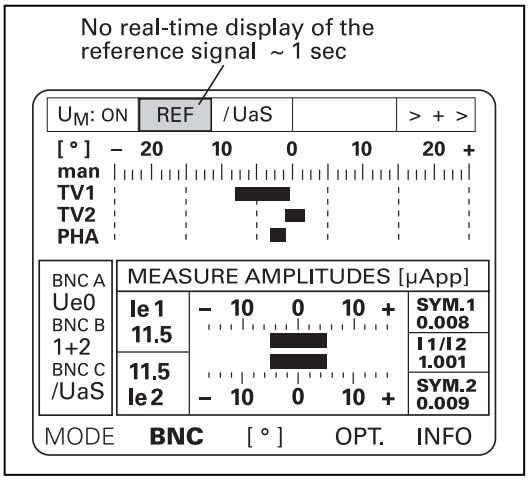


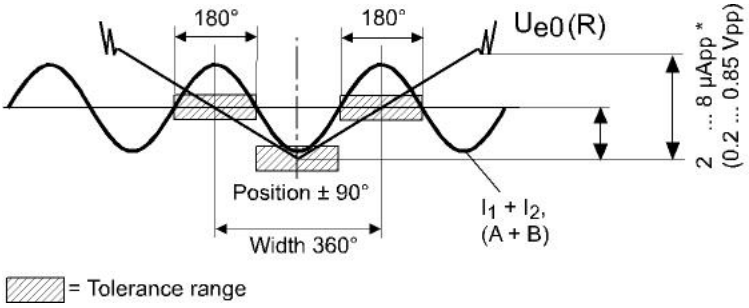
Note:
Schematic display of Ue1+2 on the oscilloscope.
The actual amplitude is higher than displayed.

PWM 8 Settings reference mark



* Interface 1 Vss



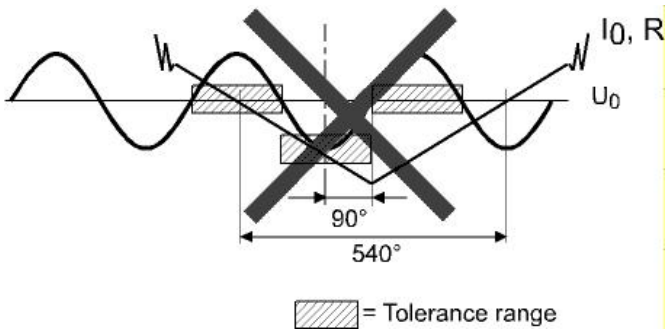


* **Old LS series:**
LS 50x; LS 80x
(e.g. LS 503; LS 803)
I0 = 5 ... 15µAss

Schematic display of I1+I2 (A+B) on the oscilloscope.

Example:
Reference mark signal

Caution: The reference-mark edges (ref. Mark / Uo line) **must not** intersect outside the tolerance range!



Note:
The quality of the output signals has an influence on the measuring accuracy of the linear and rotary encoders.
The tolerances stated are valid for standard applications of HEIDENHAIN encoders (e.g. LS on machine tools with measuring steps up to 1 µm).
For operation with encoders with higher accuracy (e.g. exposed, contactless encoders, angle encoders and encoders with highly interpolated output signals) the tolerances for the output signals are smaller.
HEIDENHAIN compares precision encoders to a measuring standard after adjustment.

12.1 Description of the Output Signal

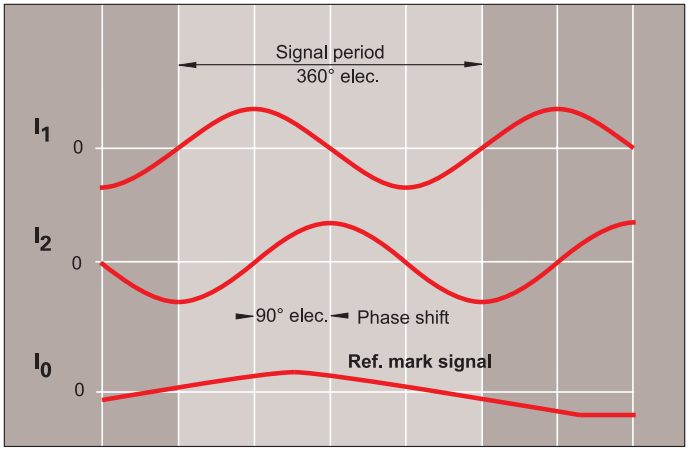
12.1.1 Output Signals

~ 11 µApp

Current signals

The sinusoidal incremental signals I_1 and I_2 are phase-shifted by 90°; their level is approx. 11 µApp. The peaks of the ref. mark signals I_0 have a usable component of ca. 5.5 µA.

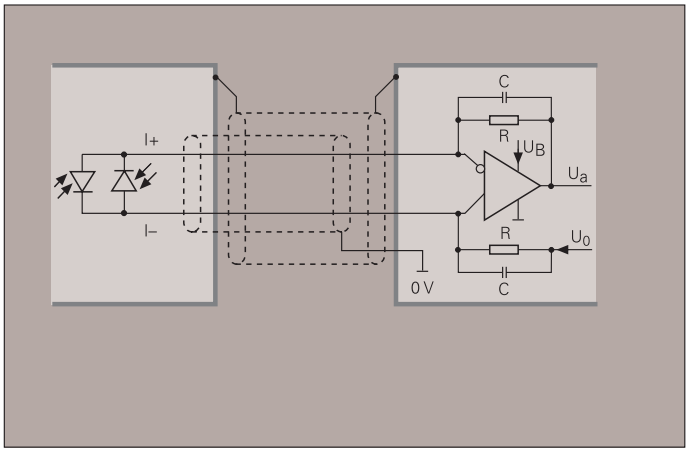
The current signal of the incremental linear encoders can be interpolated and digitized either in the subsequent electronics, e.g. HEIDENHAIN **ND** position display or **TNC** numeric control or in a separate HEIDENHAIN **EXE** interpolation and digitizing electronics. For current signals the maximum cable length between linear encoder and subsequent electronics is 30 m provided that original HEIDENHAIN cables are used.



Incremental signals
2 sinusoidal signals I_1 and I_2
signal amplitude*
I_1, I_2: 7 to 16 µApp
Reference mark signals
1 or several peaks I_0
signal amplitude with 1 kΩ load
I_0 ca. 5.5 µA (usable component)

* These values apply for Up = 5 V ± 5% at the source, cable lengths up to 30 m and a cross-section of the power supply line of 1 mm². The signal amplitude changes with increasing scanning frequency.

Recommended input circuit of the subsequent electronics



Example:

Cable length
Max. 30 m (distributed capacitance 90 pF/m) when using original HEIDENHAIN cables
-3dB cutoff frequency of input circuit
approx. 60 kHz
Dimensioning
Differential line receiver RC4157
C = 27 pF
R = 100 kΩ ± 2%
$U_0 = U_B/2$
U_B = +15 V

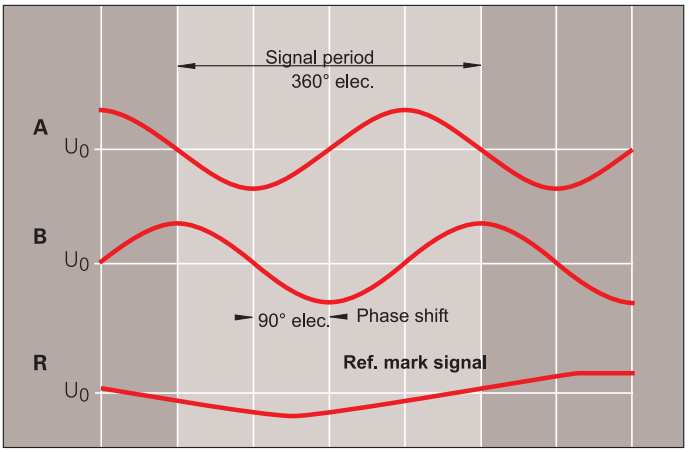
12.1.2 Output Signals

∿ 1Vpp

Voltage signals
The sinusoidal incremental signals A and B are phase-shifted by 90°; their level is approx. 1 Vpp. The peaks of the ref. mark signals have a usable component of ca. 0.5 V.
Encoders with a Z1 track additionally output the signals C and D. The specification of these signals is identical to that of the incremental signals (see section 13, adapter connector).

When using original HEIDENHAIN cables, voltage signals can be transferred over a distance of 150 m to the subsequent electronics. For this purpose a supply voltage of 5 V ± 5% or 5 V ± 10% (depending on the encoder model) must be ensured at the encoder. Encoders that output voltage signals feature connectors for the sensor lines which serve to measure the supply voltage at the unit. By means of appropriate controlling means in the subsequent electronics the tolerance of the supply voltage can be observed.
Sinusoidal voltage signals can be highly interpolated.

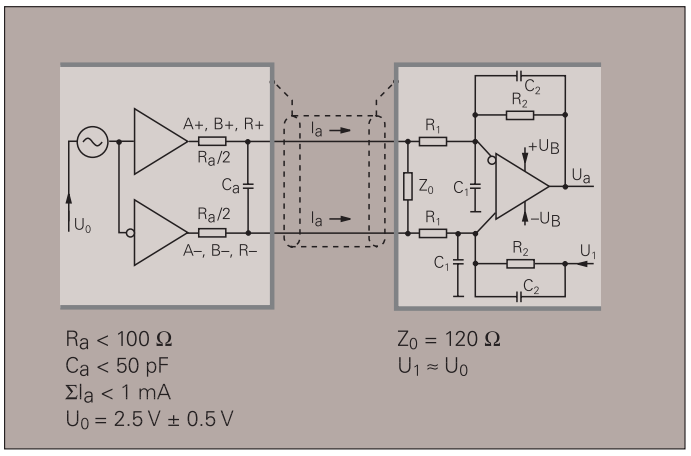
Output signals measured with PWM 8



Incremental signals
2 sinusoidal signals A and B
signal amplitude* approx. 1Vpp
A, B: 0.6 to 1.2 Vpp
with terminating resistor Z_0 = 120 Ω
Reference mark signal
1 or several peaks R
signal amplitude approx. 0.5 V
R: 0.2 to 0.8 V (usable component)
with terminating resistor Z_0 = 120 Ω

* These values apply for Up = 5 V ± 5% or Up = 5 V ± 10% at the encoder.
The signal amplitude changes with increasing scanning frequency.

Recommended input circuit of the subsequent electronics



Example:

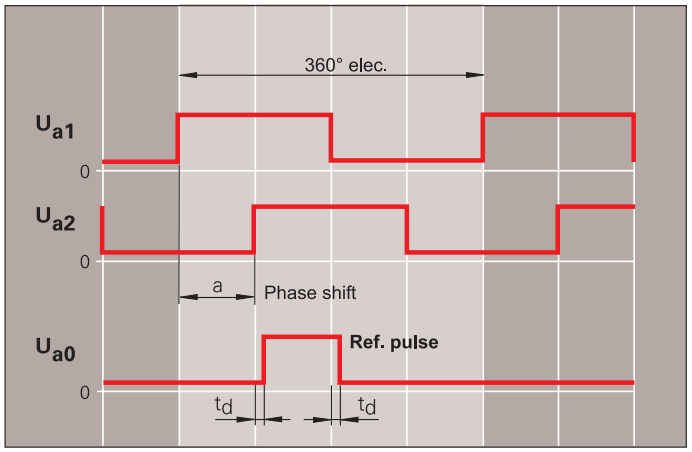
Cable length
Max. 150 m (distributed capacitance 90 pF/m) when using original HEIDENHAIN cables
-3dB cutoff frequency of input circuit
approx. 100 kHz
Dimensioning
Differential line receiver RC4157
R_1 = 10 kΩ and C_1 = 220 pF
R_2 = 34,8 kΩ and C_2 = 10 pF
U_B = ± 15V

12.1.3 Output Signals

⊓⊔ TTL

TTL square-wave signals

Encoders that output TTL square-wave signals feature electronics that digitize the sinusoidal scanning signals without interpolation.
Two TTL square-wave signals Ua1 and Ua2 that are phase-shifted by 90° are output together with the reference pulse Ua0 gated with the incremental signals Ua1 and Ua2. Encoders with distance-coded reference marks output several Ua0 reference pulses.
The measuring step results from the distance between two edges of the signals Ua1 and Ua2.
To each square-wave signal the integral electronics in addition outputs the corresponding inverted signal.



Incremental signals — TTL square-wave signal trains Ua1, Ua2 and their inverted signal trains $\overline{Ua1}$ and $\overline{Ua2}$.
Ua2 lags Ua1 with ccw rotation (view on shaft or on encoder flange) or when the scanning unit moves away from the ID plate - of the linear encoder.

Edge separation
- a ≥ 0.4 µs at 400 kHz scanning frequency
- a ≥ 0.45 µs at 300 kHz scanning frequency
- a ≥ 0.8 µs at 160 kHz scanning frequency
- a ≥ 1.3 µs at 100 kHz scanning frequency

The scanning frequency depends on the encoder model.

Reference mark signal — 1 square-wave pulse Ua0 and its inverted pulse $\overline{Ua0}$
- Pulse width: 90° elec.
- Delay time: $|t_d| \leq 50$ ns

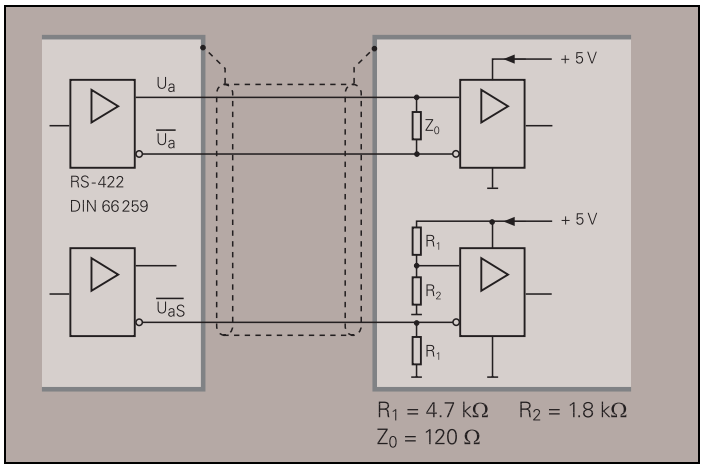
Fault detection signal — 1 square-wave pulse $\overline{UaS}$
(single-ended signal: max. cable length 50m)
$\overline{UaS}$ = LOW: fault detected
$\overline{UaS}$ = HIGH: device operates properly

TTL signal level	$U_H \geq 2.5$ V with $-I_H = 20$ mA	
	$U_L \leq 0.5$ V with $I_L = 20$ mA	
Load capacity	$-I_H \leq 20$ mA	
	$I_L \leq 20$ mA	
	$C_{Load} \leq 1000$ pF	
Switching times	Rise time:	$t_+ \leq 100$ ns
	Fall time:	$t_- \leq 100$ ns

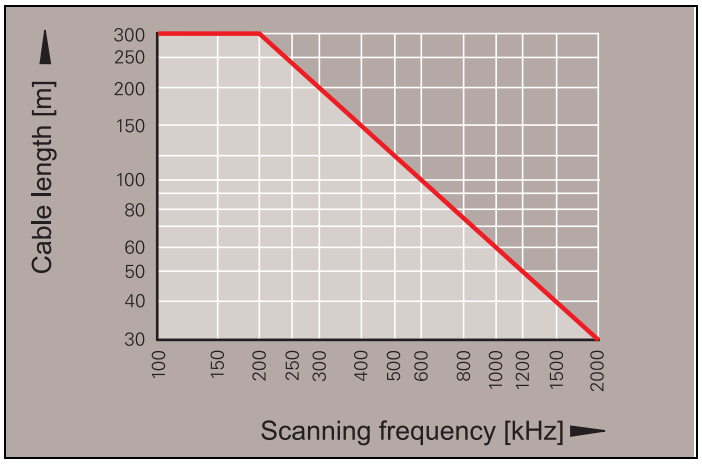
The **fault detection signal** $\overline{\textbf{UaS}}$ indicates a malfunction, such as break of a supply line, lamp failure etc.

TTL square-wave signals can be transferred over cable lengths up to 300 m to the subsequent electronics. For this purpose a supply voltage of 5 V ± 10% (for RAN 460: range between 10 and 30 V) must be ensured at the linear or rotary encoder.
In the subsequent electronics TTL square-wave signals can be interpolated 100-fold max. by means of phase-locked control loops.

Recommended input circuit of the subsequent electronics



Recommended differential line receivers
AM 26 LS 32
MC 3486
SN 75 ALS 193
SN 75 ALS 195

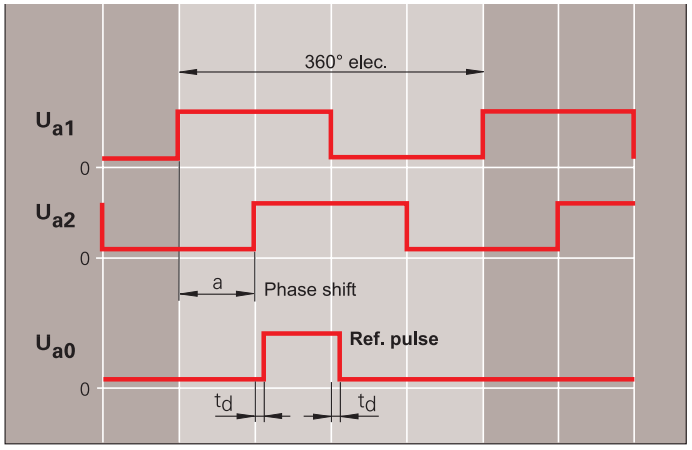


We recommend not to exceed the cable length related to the scanning frequency, since otherwise the switching times resp. the edge gradient cannot be maintained.

12.1.4 Output Signals

⊓⊔ HTL

HTL square-wave signals
The design of encoders with HTL square-wave signals is similar that of encoders with TTL square-wave signals. Output signals are HTL square-wave pulse trains Ua1 and Ua2 together with the reference pulse Ua0 that is gated with the incremental signals Ua1 and Ua2.
To each square-wave pulse train the integral electronics in addition outputs the corresponding inverted signal (not with ERN 1030). The outputs of encoder with HTL square-wave signals are short-circuit proof at room temperature.



Incremental signals: HTL square-wave pulse trains Ua1 and Ua2 and their inverted pulse trains $\overline{Ua1}$ and $\overline{Ua2}$ (ERN 1030: no inverted pulse trains).
Ua2 lags Ua1 with ccw rotation (view on shaft or encoder flange).

Edge separation
a ≥ 0.45 µs at 300 kHz scanning frequency
a ≥ 0.8 µs at 160 kHz scanning frequency

The scanning frequency depends on the encoder model and can be seen from the specifications.

Ref. mark signal 1 square-wave pulse Ua0 and its inverted pulse $\overline{Ua0}$
ERN 1030: no $\overline{Ua0}$

Pulse width 90° elec.
Delay time $|t_d| \leq 50$ ns for gated ref. pulse

Fault detection signal 1 square-wave pulse $\overline{UaS}$
$\overline{UaS}$ = LOW: fault detected
$\overline{UaS}$ = HIGH: encoder operates properly
(short circuit not permissible after Up)
ERN 1030: no fault detection signal $\overline{UaS}$

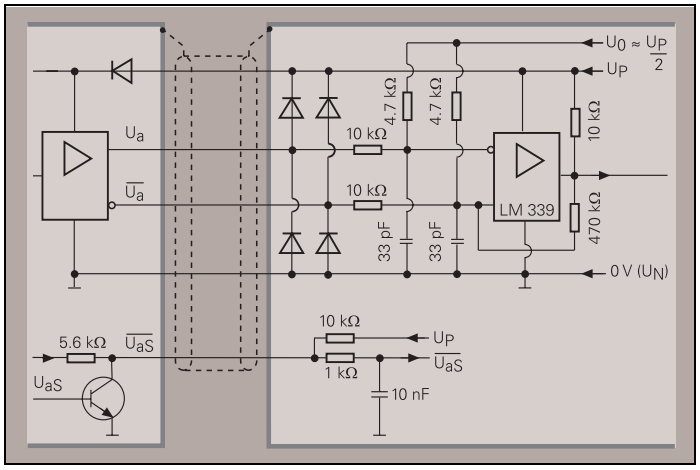
Signal level HTL
$U_H \geq 21$ V with $-I_H = 20$ mA
$U_L \leq 2.8$ V with $I_L = 20$ mA
if supply voltage is +24 V, without cable

Load capacity
$-I_H \leq 200$ mA (not true for $\overline{UaS}$)
$I_L \leq 200$ mA
$C_{Load} \leq 1000$ pF

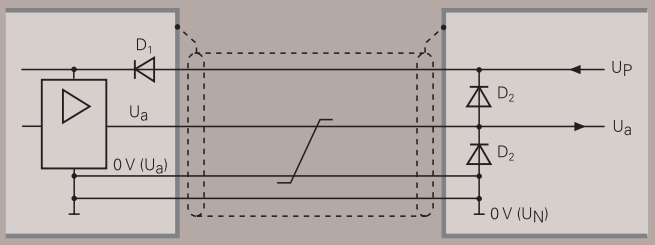
Switching times
Rise time: $t_+ \leq 200$ ns
Fall time: $t_- \leq 200$ ns

HTL square-wave signals can be transferred over cable lengths up to 300 m (ERN 1030: 100 m) to the subsequent electronics (PLC etc.).

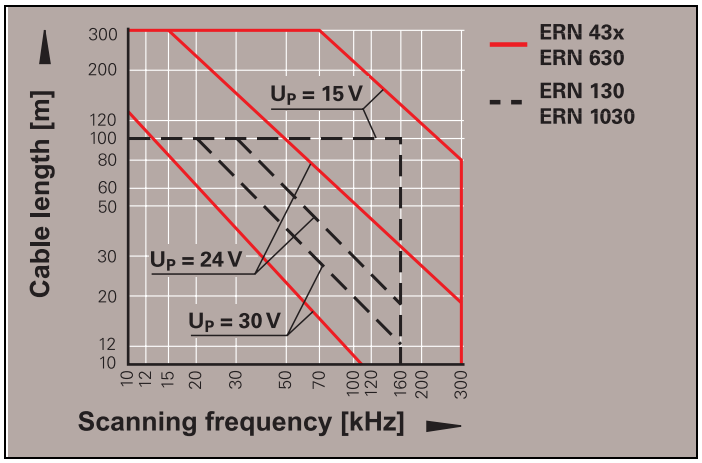
We recommend not to exceed the cable length related to the scanning frequency and to the power supply, since otherwise the switching times resp. the edge gradient cannot be maintained.
In the subsequent electronics HTL square-wave signals can be interpolated 100-fold max. by means of phase-locked control loops.



ERN 1030



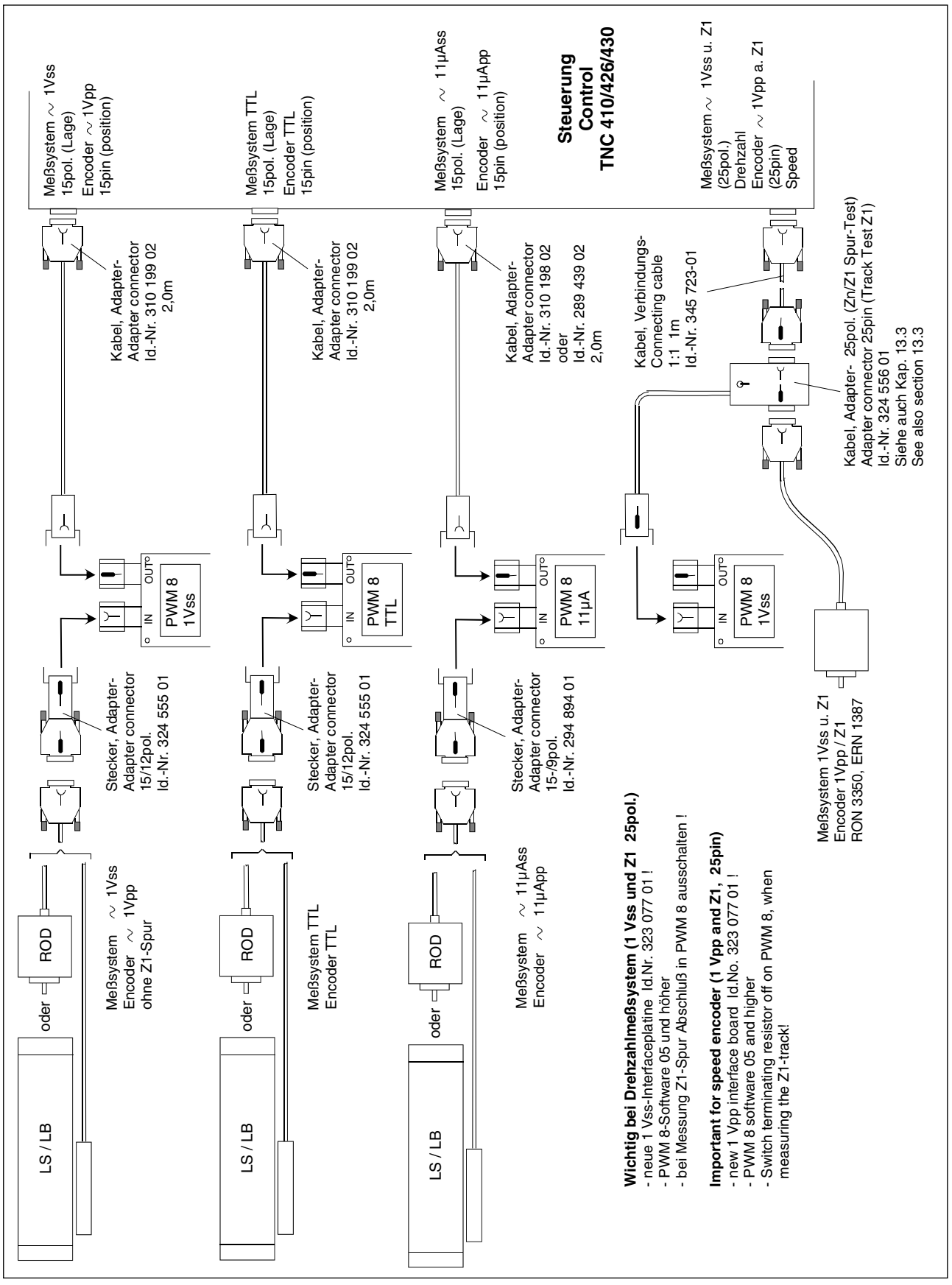
If the cable is longer than 50 m, the 0V signal lines must be connected to 0V of the subsequent electronics to increase noise immunity.



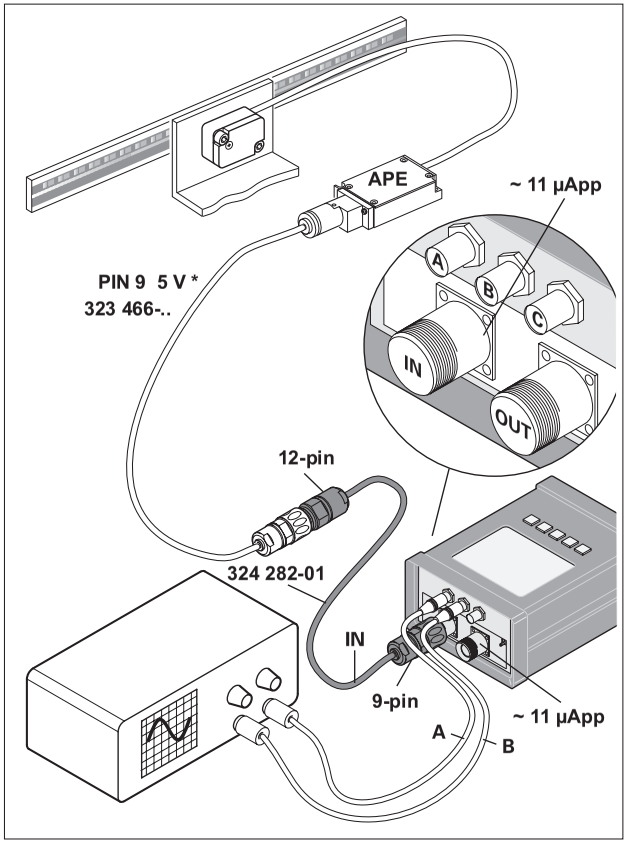
The permissible cable length depends on the scanning frequency and on the power supply.

13. Adapter Connectors

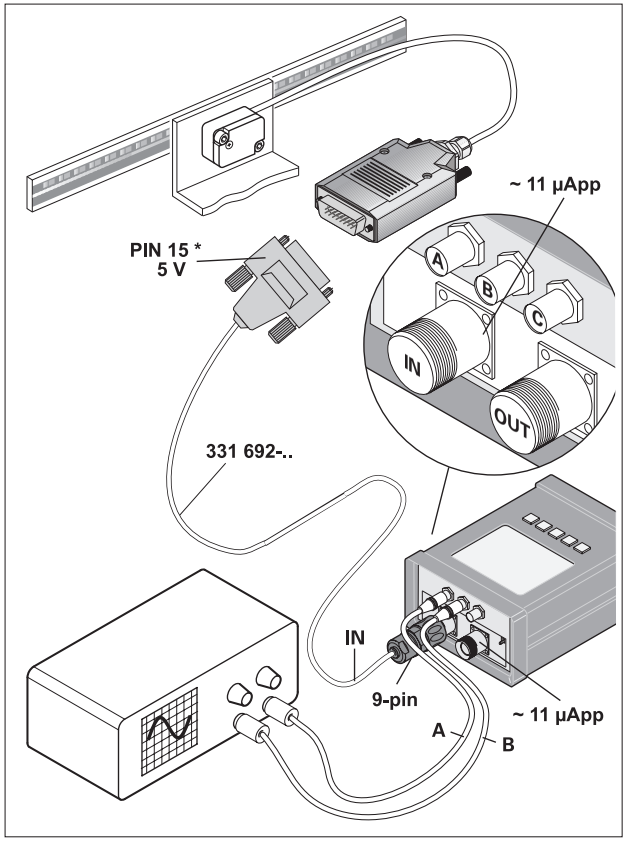
13.1 Overview of the Adapter Connectors



13.2 Adapter connector for exposed linear encoders (TTL output signals)

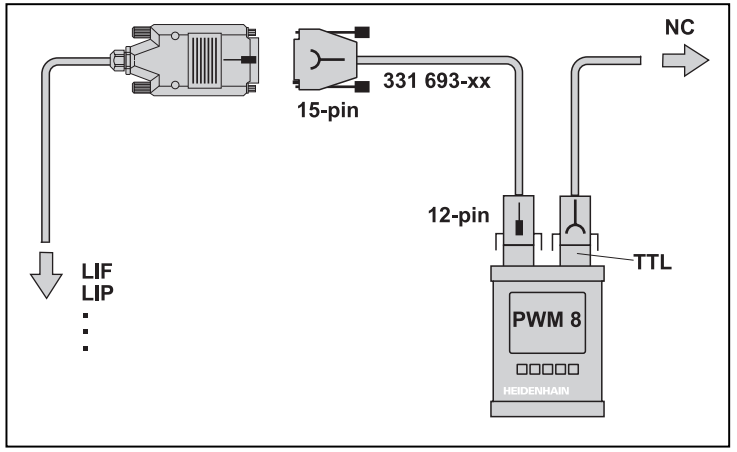


Units with APE:
LIF 12
LIF 17
LIP 37
LIP 47
LIP 57



Units with D-Sub connector:

LIF 17	MT 1271
LIP 47	MT 2571
LIP 57	ST 1271
LIDA 17	ST 1277
LIDA 42	ST 3078
LIDA 47	



For inspecting the TTL output signals the adapter cable Id.No. 331 693-xx is required.

- **NOTE:** The above adapter cables convert the output signals from TTL to 11 µApp.

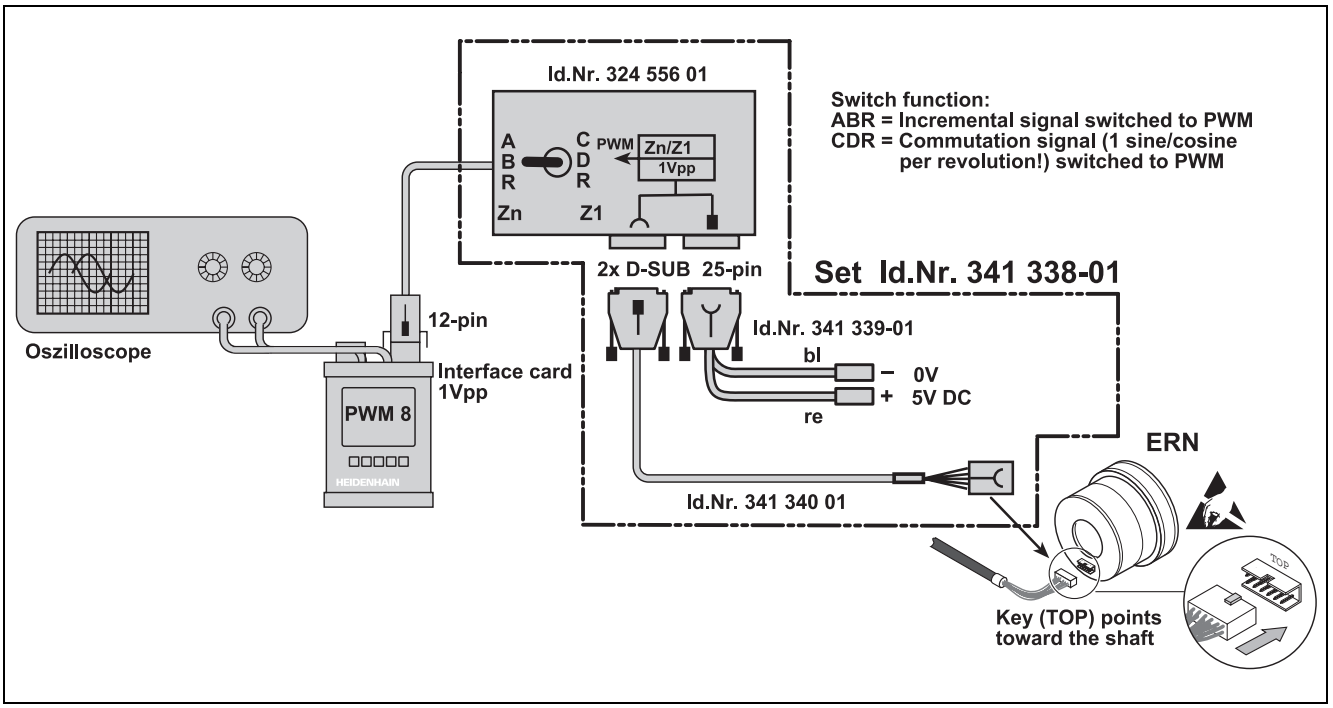
No feed-through mode possible!

13.3 Adapter-connector for ERN 1387

Test adapter set for rotary encoders with analog commutating signals
(e.g. ERN 1387 with incremental track Zn and commutating track Z1)

Testing the ERN 1387 without subsequent electronics!

Adapter set Id.No. 341 338-01



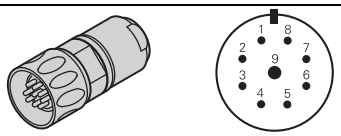
Note:	If the ERN is tested without subsequent electronics, the terminating resistor on the PWM 8 must be switched off. See PWM 8 Operating Instructions Id.No. 312 737 91 page 13 softkey options. The terminating resistors are integrated in the D-sub connector Id.No. 341 339 01!

CAUTION:	If the ERN is to be tested without subsequent electronics (NC), the adapter cable Id.No. 341 340 01 (see graphic) must always be used! The 17-pin right-angle flange socket on the servo drive may have different!

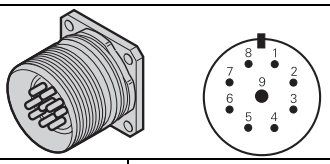
14. Pin Layouts of Standard HEIDENHAIN Cables

∿ 11µApp

9-pin
HEIDENHAIN connector

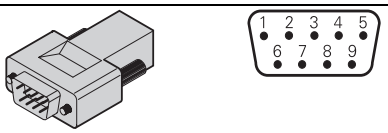


9-pin
flange socket



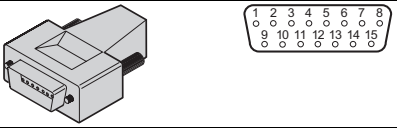
1	2	3	4	5	6	7	8	9	housing
I_1	I_1	5V Up	0V U_N	I_2	I_2	I_0	I_0	internal shield	external shield
+	–			+	–	+	–		
Green	Yellow	Brown	White	Blue	Red	Gray	Pink	White/brown	

9-pin D-sub-connector
for HEIDENHAIN IK 121A counter card



1	2	3	4	5	6	7	8	9	housing
I_1	0V U_N	I_2	internal shield	I_0	I_1	5V Up	I_2	I_0	external shield
–		–		–	+		+	+	
Yellow	White	Red	White/brown	Pink	Green	Brown	Blue	Gray	

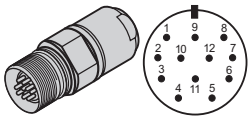
15-pin D-sub-connector
for HEIDENHAIN contouring control TNC 410, TNC 426, TNC 430



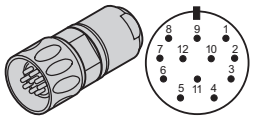
1	2	3	4	5	6	7	10	12	housing
5V Up	0V U_N	I_1	I_1	internal shield	I_2	I_2	I_0	I_0	external shield
		+	–		+	–	+	–	
Brown	White	Green	Yellow	White/brown	Blue	Red	Gray	Pink	

⊓⊔ TTL

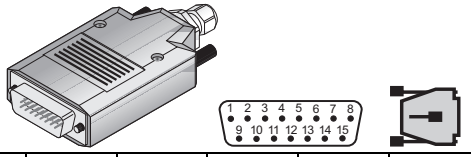
12-pin HEIDENHAIN-coupling



12-pin HEIDENHAIN-connector



15pin D-sub-connector (male) at LIF 171

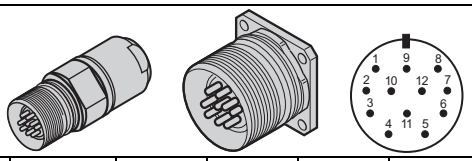


	5	6	8	1	3	4	12	10	2	11	9	7	/	housing
	1	9	3	11	14	7	4	2	12	10	/	13	15	external shield
	Ua1	$\overline{Ua1}$	Ua2	$\overline{Ua2}$	Ua0	$\overline{Ua0}$	5V Up	0V U_N	5V sensor	0V sensor	frei	$\overline{UaS}$	1)	
	Brown	Green	Gray	Pink	Red	Black	Brown/ green	White/ green	Blue	White	/	Violet	Yellow	
							IEC742 EN 50178							

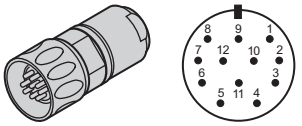
Sensor line internally connected to power supply line. **Shield** on housing.
1) Switchover TTL/11µApp

1 Vpp

12-pin HEIDENHAIN-flange socket or coupling



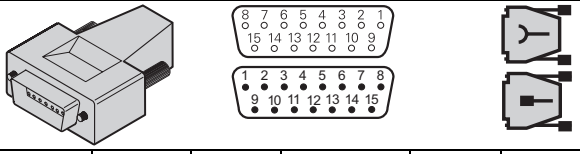
12-pin HEIDENHAIN-connector



1	2	3	4	5	6	7	8	9	10	11	12	/	housing
B	**5V Sensor**	**R**	**R**	**A**	**A**	**/**	**B**	**vacant**	**0V U_N**	**0V Sensor**	**5V Up**	**vacant**	**external shield**
–		+	–	+	–		+						
pink	blue	red	black	brown	green	violet	gray	/	white/ green	white	brown/ green	yellow	

Sensor line internally connected to power supply line. **Shield** on housing.

15-pin D-sub-connector (female)
for HEIDENHAIN contouring control TNC 410, TNC 426, TNC 430
15-pin D-sub-connector (male)
for HEIDENHAIN IK 121 V Counter Card for PCs

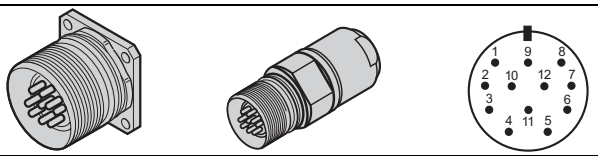


	3	4	6	7	10	12	1	2	9	11	5/8/ 13/15	14	/	housing
	1	9	3	11	14	7	4	2	12	10	5/6/ 8/15	13	/	external shield
	A		**B**		**R**		**5V Up**	**0V U_N**	**5V Sensor**	**0V Sensor**	**vacant**	**vacant/ do not use**	**vacant**	
	+	–	+	–	+	–								
	brown	green	gray	pink	red	black	brown/ green	white/ green	blue	white	/	violet	yellow	

Sensor line internally connected to power supply line. **Shield** on housing.

HTL

12-pin HEIDENHAIN-flange socket or -coupling



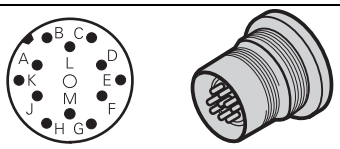
1	2	3	4	5	6	7	8	9	10	11	12	/	housing
$\overline{Ua2}$	**10 to 30 V** Sensor	**Ua0**	**$\overline{Ua0}$**	**Ua1**	**$\overline{Ua1}$**	**$\overline{UaS}$**	**Ua2**	**vacant**	**0V** (U_N)	**0V** Sensor	**10 to 30 V** (Up)	**vacant**	**external shield**
pink	blue	red	black	brown	green	violet	gray	/	white/ green	white	brown/ green	yellow	

Sensor line internally connected to power supply line. **Shield** on housing.

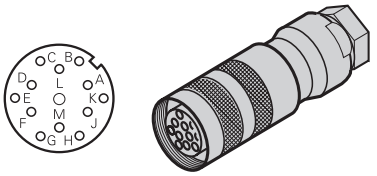
ROD 1030/ERN 1030 without inverse signals $\overline{Ua1}$, $\overline{Ua2}$ and $\overline{Ua0}$.

TTL **

12-pin flange socket (model: Binder)



12-pin connector (straight or offset) (model: Binder)



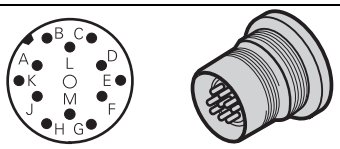
A	B	C	D	E	F	G	H	J	K	L	M	/	housing
$\overline{Ua2}$	**5V *** Sensor	**Ua0**	**$\overline{Ua0}$**	**Ua1**	**$\overline{Ua1}$**	**$\overline{UaS}$**	**Ua2**	**vacant**	**0V** (U_N)	**0V** Sensor	**5V** (Up)	**vacant**	**external shield**
pink	blue	red	black	brown	green	violet	gray	/	white/ green	white	brown/ green	yellow	

Sensor line internally connected to power supply line. **Shield** on housing.

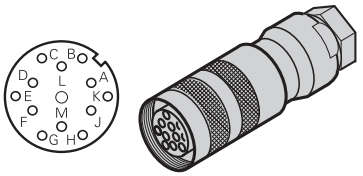
* ERN 460 has a power supply of 10 to 30 V.
** Adapter cable on request

HTL

12-pin flange socket (model: Binder)



12-pin connector (straight or offset) (model: Binder)

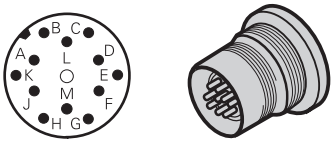


A	B	C	D	E	F	G	H	J	K	L	M	/	housing
$\overline{Ua2}$	**10 to 30 V** Sensor	**Ua0**	**$\overline{Ua0}$**	**Ua1**	**$\overline{Ua1}$**	**$\overline{UaS}$**	**Ua2**	**vacant**	**0V** (U_N)	**0V** Sensor	**10 to 30 V** (Up)	**vacant**	**external shield**
pink	blue	red	black	brown	green	violet	gray	/	white/ green	white	brown/ green	yellow	

Sensor line internally connected to power supply line. **Shield** on housing.

1 Vpp

12-pin flange socket (model: Binder)



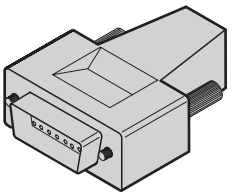
12-pin connector (straight or offset) (model: Binder)

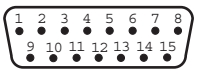
A	B	C	D	E	F	G	H	J	K	L	M	/	housing
B	**5V** Sensor	**R**	**R**	**A**	**A**	**vacant**	**B**	**vacant**	**0V** (U_N)	**0V** Sensor	**5V** (Up)	**vacant**	**external shield**
–		+	–	+	–		+						
pink	blue	red	black	brown	green	violet	gray	/	white/ green	white	brown/ green	yellow	

Sensor line internally connected to power supply line. **Shield** on housing.

TTL EXE Output Signals

EXE 604C
15-pin D-Sub connector
(colors apply for HEIDENHAIN cable)

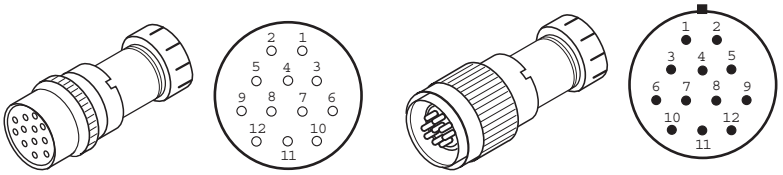




1	2	3	4	5	6	7	8	9	10	11	12
Ua1	**$\overline{\text{Ua1}}$**	**Ua2**	**$\overline{\text{Ua2}}$**	**5V Sensor**	**Ua0**	**$\overline{\text{Ua0}}$**	**$\overline{\text{UaS}}$**	**5V Up**	**0V Sensor**	**n.c.**	**0V U_N**
brown	green	grey	pink	blue	red	black	violet	brown/ green	white	/	white/ green

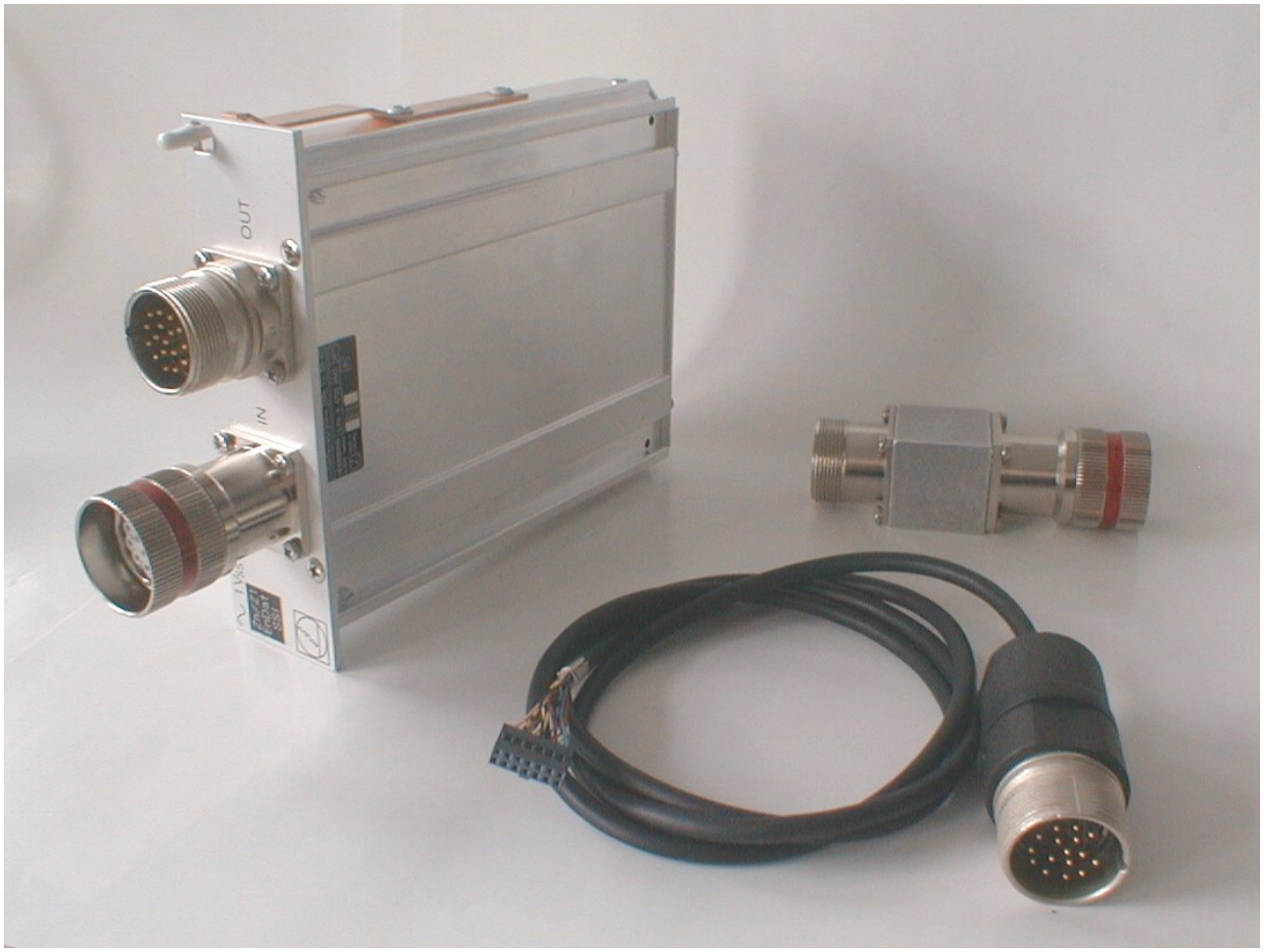
Sensor line internally connected to power supply line. **Shield** on housing.

EXE 605S
12-pin coupling (Souriau)
EXE 604C
12-pin connector (Souriau)
(colors apply for HEIDENHAIN cable)



1	2	3	4	5	6	7	8	9	10	11	12
Ua1	**$\overline{\text{Ua1}}$**	**Ua2**	**$\overline{\text{Ua2}}$**	**5V Sensor**	**Ua0**	**$\overline{\text{Ua0}}$**	**$\overline{\text{UaS}}$**	**5V Up**	**0V Sensor**	**Shield**	**0V U_N**
brown	green	grey	pink	blue	red	black	violet	brown/ green	white	/	white/ green

15. Description of the interface board, 1 Vpp, absolute (with Zn/Z1-track; EnDat/SSI; SSI-programmable)



15.1 General information

This 1Vpp interface board has been designed for testing measuring systems with Zn/Z1 1Vpp output signals, EnDat/SSI and programmable SSI interfaces.
The interface board features 17-pin HEIDENHAIN flange sockets.
The measuring system can be selected via the parameter P9 in the EXPERT MODE of PWM8.

15.1.1 1 Vpp measuring systems with Zn/Z1 track

e.g. ERN 1185, ERN 138x (with commutating track)

The interface board permits switching between the two output-signal tracks (AB and CD). The encoder signals can be fed through the PWM8 to an oscilloscope. For the tracks AB and CD switchable terminating resistors are provided on the interface board. The remaining functions of PWM8 can also be used for the CD track provided that the lower cutoff frequencies are observed. (Commutating track CD = 1 signal period per revolution!)

Note:
Do not exceed the mechanical shaft speed!

The interface board replaces the 1Vpp Zn/Z1 adapter Id.No. 324566-01 (part of the cable adapter set for PWM8, Id.No. 341338-01). All encoder supply types of PWM8 are possible (INTERNAL, EXTERNAL, EXTERNAL FROM CUSTOMER). An adapter cable is required to connect 1Vpp measuring systems with Zn/Z1 track with different wirings to this interface board; by means of this cable the encoder signals can be tapped directly at the measuring system. (see section: HEIDENHAIN output cable with 14-pin PCB connector)

Note:
The reference pulse of this measuring system is derived from the AB track. The CD track is not directly connected to the reference signal!

15.1.2 1 Vpp measuring systems with EnDat interface

With this setting of the interface board, 1Vpp measuring systems with EnDat or SSI interface can be operated via PWM8 in feed-through mode. All encoder supply types of PWM8 are possible: INTERNAL, EXTERNAL, EXTERNAL FROM CUSTOMER. The encoder is powered with 5V (selectable in the EXPERT MODE). The analog 1Vpp signals can be fed through the PWM8 to an oscilloscope. The remaining functions of PWM8 can be used for the analog 1Vpp signals. Please consider that EnDat encoders do not have a reference pulse. With these encoders the internal counter of PWM8 cannot be started by reference pulse; display of the reference pulse is not possible!
The digital signals of the EnDat interface can also be switched to the BNC sockets. **Further evaluations of the EnDat or SSI signals can not be made with this interface board.**

Note:
If digital and analog signals are switched to the BNC sockets simultaneously, crosstalking of the digital signals to the analog signals is to be expected. The higher the band width of the oscilloscope connected, the more obviously the crosstalking effect can be seen.
With the encoder output (OUT) of the interface board this effect does not occur.

15.1.3 1 Vpp measuring systems with SSI interface and 5V supply voltage

Same functions as 1 Vpp measuring systems with EnDat interface
(see section: 1 Vpp measuring systems with EnDat interface)

15.1.4 1 Vpp measuring systems with SSI interface and HTL supply voltage

For the software version 10 applies:

Same functions as 1 Vpp measuring systems with EnDat interface (see section: 1 Vpp measuring systems with EnDat interface) To be able to set the power supply for HTL encoders, these encoders must be operated with the parameter setting P9 = ***"PROG. SSI"***. The additional parameter functions of the programmable SSI interface must not be used for these encoders! Switching to HTL encoder supply is described in the section **Switching the encoder supply to HTL**.

The sensor connection can be set in the parameter P10. Recommended setting: "*AUTO*" (see also section **Parameter P10 "Sensor connection" with programmable SSI encoders**).

Caution:
To avoid malfunctions or destruction of the encoder the offered programming features must not be used for this HTL application!

As of the software version 11 applies:

Same functions as 1Vpp measuring systems with EnDat interface (see section 1Vpp measuring systems with EnDat interface).

These measuring systems are operated with the parameter setting P9 = **"SSI/EnDat"**. The additional functions of the programmable SSI interface are **not available** with these measuring systems and therefore not offered by the software. Switching to HTL encoder supply is described in the section **Switching the encoder supply to HTL**.

15.1.5 1 Vpp measuring systems with programmable SSI interface

Same functions as 1Vpp measuring systems with EnDat interface (see section 1Vpp measuring systems with EnDat interface).

In addition these measuring systems offer the following characteristic features:

1. The following functions can be programmed:
   PIN 2 (IN): Changing the direction of rotation by applying Up
   PIN 5 (IN): Preset 1 – any desired position determined via the programming software can be loaded by applying Up for > 1ms.
   PIN 6 (IN): Preset 2 – any desired position determined via the programming software can be loaded by applying Up for > 1ms.
2. Additional serial interface instead of the sensor lines for further programming functions.
3. HTL encoder supply (10V-30V)
4. General encoder interference signal at PIN3.

The PWM displays this interference signal as "/UaS2" in the LC display instead of the "REF display" (possible as of interface board Id.No. 312186-01 with hardware index b). The "/UaS2" is not the same as the "/UaS" interference signal. The "/UaS2" signal is generated on the interface board, the "/UaS" signal by the encoder and fed to the PWM via PIN3.

In the setting "programmable SSI" the interface board is prepared for the additional functions. In order to enable the interface board to execute these functions, the related menu must be activated through a key combination.

For reasons of safety the HTL supply for the programmable SSI measuring systems must be switched on by the operator in the additional menu. If HTL supply is activated, the sensor lines of the measuring system are connected to the subsequent electronics through the PWM8. Thus, the additional serial interface is operative.

If the measuring system is to be powered from an external power source (= U_MSYS EXT) with the HTL supply switched on, the parameter "*P2 = U_MSYS EXTERN*" must be set to "*FROM CUSTOMER*". The PWM8 automatically activates the parameter P2. The parameter option "*P2 = FLOATING*" is not possible!

16 Items supplied

16.1 Hardware

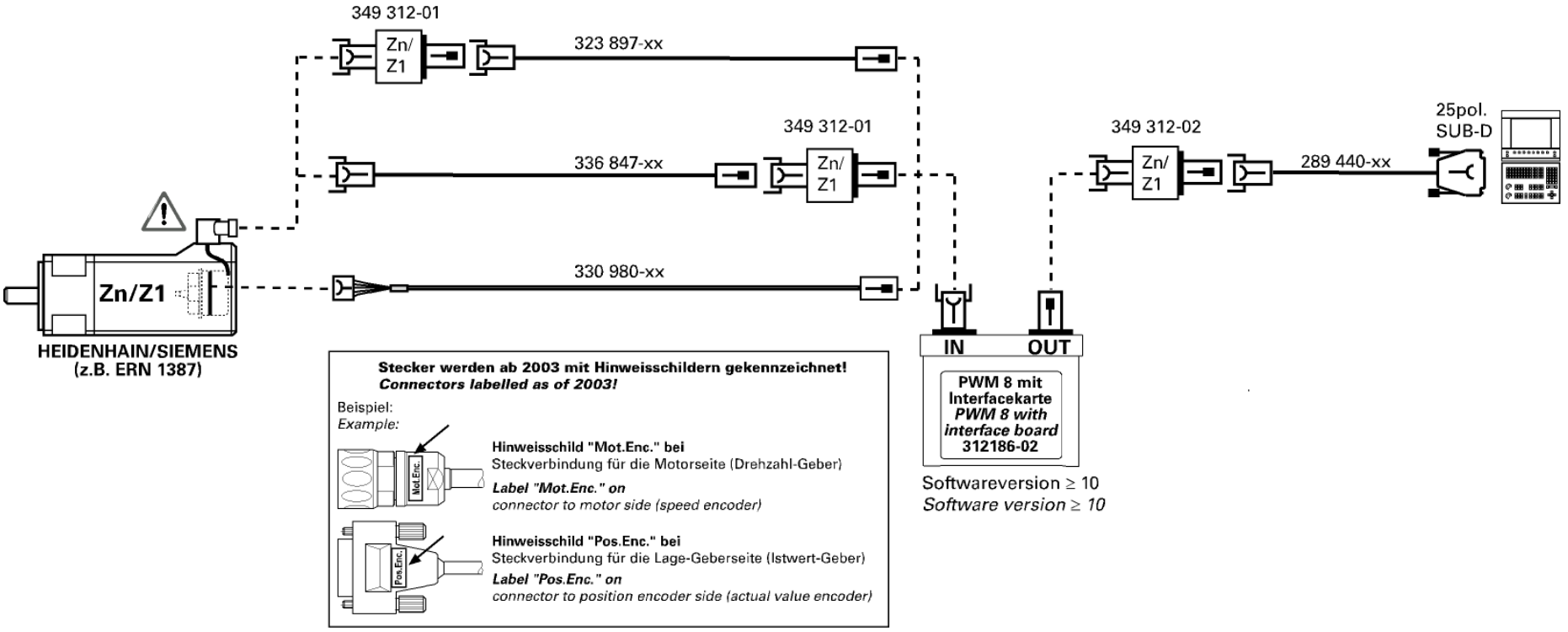
Interface board ~1 Vpp with Zn/Z1, EnDat, SSI	Id.No. 312186-xx

16.2 Adapter Cables overview

	Id.No.	see section
Adapter kit 1 Adapter Zn/Z1 IN Adapter Zn/Z1 OUT	 349312-01 349312-02	 18.9.1 18.9.1
Adapter kit 2 Adapter EnDat/SSI IN Adapter EnDat/SSI OUT	 349312-03 349312-04	 18.9.2 18.9.2
Adapter cables Adapter cable with 12-pin PCB connector for 1Vpp encoders with EnDat or SSI (Pos.Enc.EnDat) Adapter cable with 14-pin PCB connector for 1Vpp encoders with Zn/Z1 track (Pos.Enc.EnDat)	 349839-xx 330980-xx	 18.10.1 18.10.2
Adapter cable, 17/17-pin, PWM to motor (Pos.Enc.EnDat)	323897-xx	18.11
Adapter cable to IK115 interface board	324544-xx	18.12
5V voltage controller for cable lengths > 6m (Pos.Enc.EnDat); HEIDENHAIN	370225-01	16.4
5V voltage controller for cable lengths > 6m (Mot.Enc.EnDat); SIEMENS	370224-01	16.5
Adapter cable, 17/17-pin, PWM to motor (Mot.Enc.EnDat)	340302-xx	18.13
Adapter cable, 17/15-pin, PWM to subsequent electronics (Mot.Enc.EnDat)	332115-xx	18.14
Adapter cable, 17/25-pin, PWM to subsequent electronics (Mot.Enc.1Vss)	289440-xx	18.15
Adapter cable, 17/25-pin, PWM to subsequent electronics (Mot.Enc.EnDat)	336376-xx	18.16
Adapter cable, 17/17-pin, PWM to motor (Pos.Enc.EnDat)	336847-xx	18.17

Note:
For connection via the flange socket of the motor encoder always use the adapter kit (1 or 2)!
(SIEMENS pin layout adapted to HEIDENHAIN pin layout)

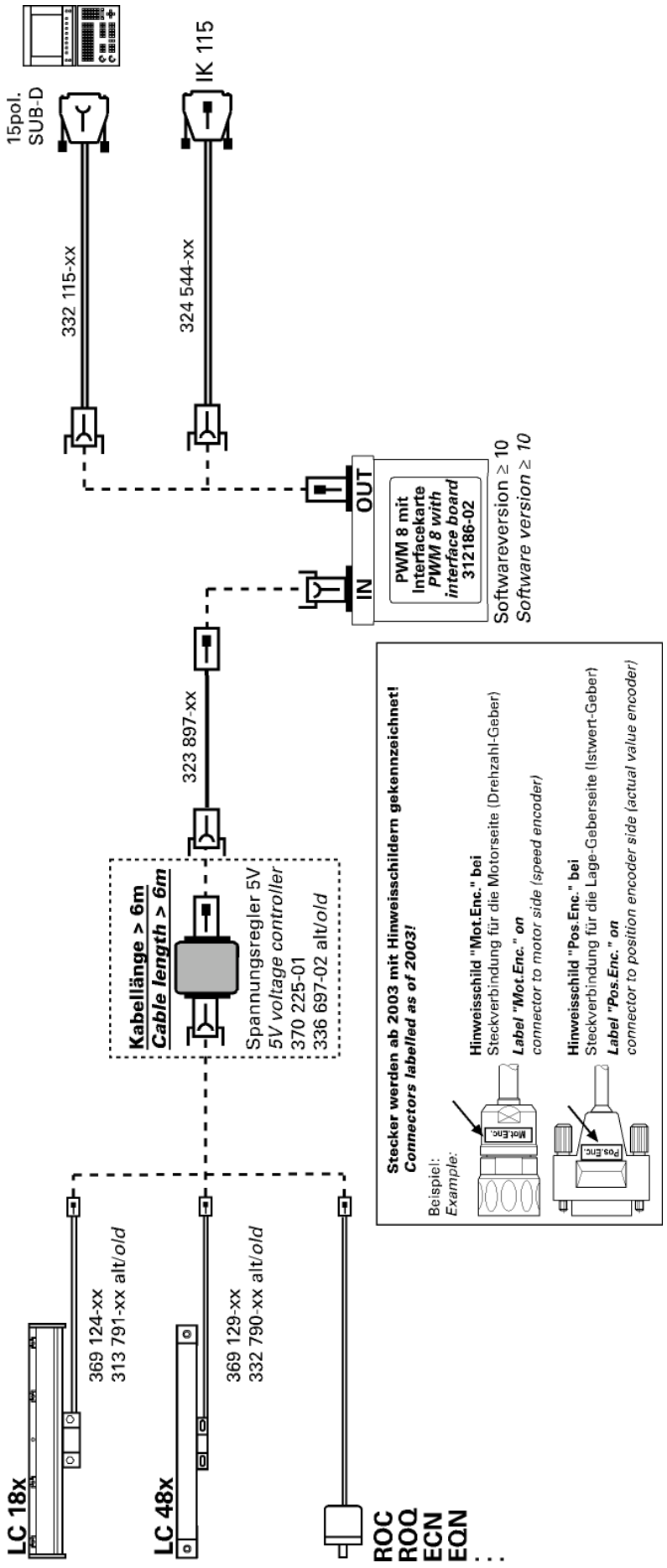
Inkremental Zn/Z1
Incremental Zn/Z1



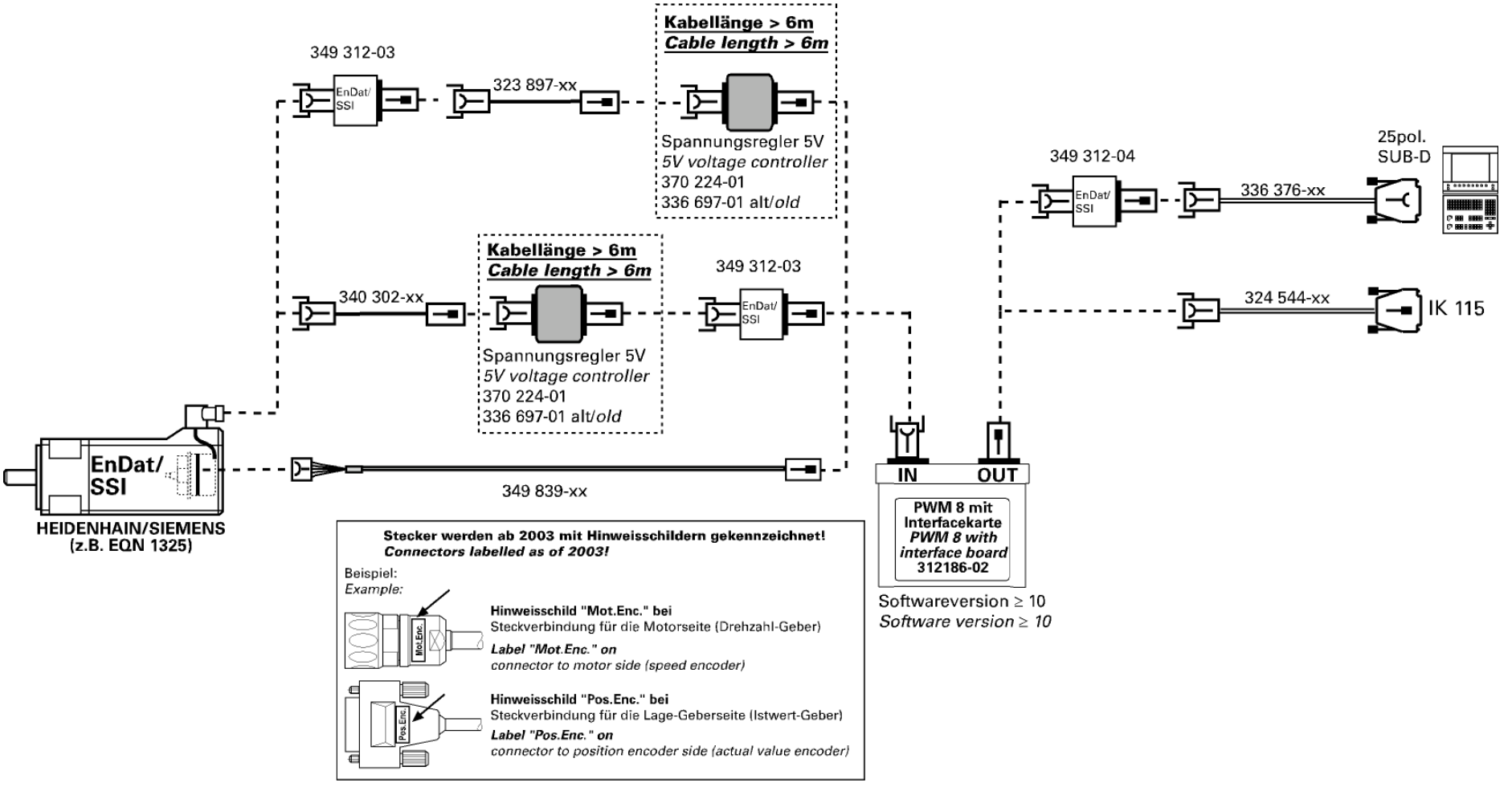
Achtung: **Motorflanschdose mit HEIDENHAIN/SIEMENS-Belegung - immer die Zwischenadapter (349 312-xx) verwenden, andernfalls kann der Drehgeber bzw. das PWM zerstört werden! HEIDENHAIN-Antriebe verwenden SIEMENS-Belegung!**

Caution: ***Motor flange socket with HEIDENHAIN/SIEMENS layout: always use the intermediate adapters (349 312-xx), since otherwise the encoder or the PWM may be destroyed! HEIDENHAIN servo drives operate with SIEMENS pin layout!***

16.4 Absolute EnDat/SSI



Absolut EnDat/SSI Antriebsgeber
Absolute EnDat/SSI motor encoder



Achtung: **Motorflanschdose mit HEIDENHAIN/SIEMENS-Belegung - immer die Zwischenadapter (349 312-xx) verwenden, andernfalls kann der Drehgeber bzw. das PWM zerstört werden!**
HEIDENHAIN-Antriebe verwenden SIEMENS-Belegung!

Caution: ***Motor flange socket with HEIDENHAIN/SIEMENS layout: always use the intermediate adapters (349 312-xx), since otherwise the encoder or the PWM may be destroyed!***
HEIDENHAIN servo drives operate with SIEMENS pin layout!

17 Software Description

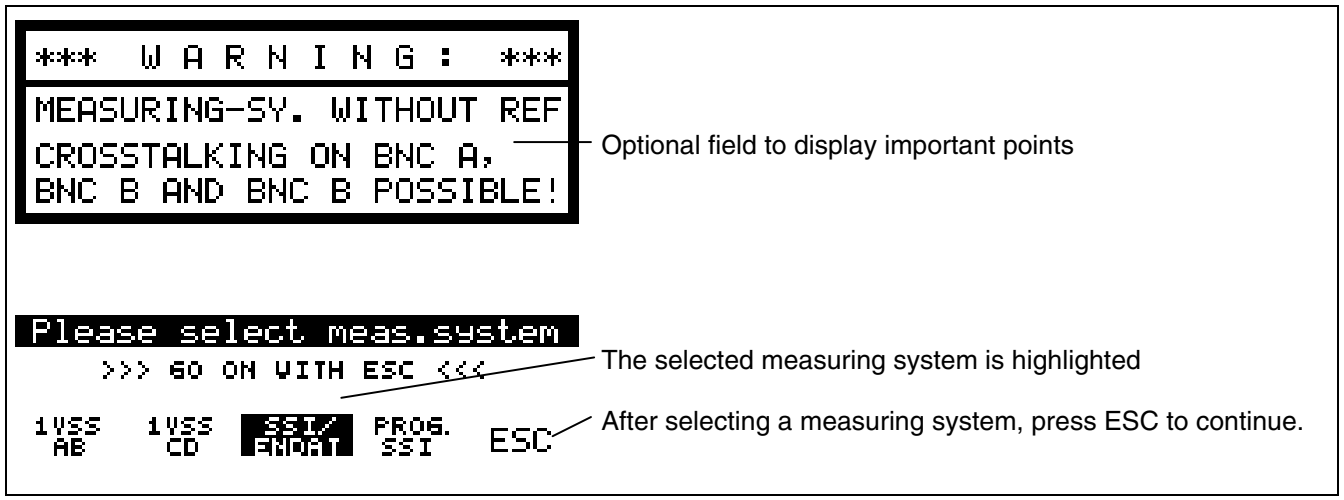
17.1 Required software version

To operate the interface board Id.No. 312186-02 the PWM8 software version 246199-**10** (246200.**10**) or higher is required.

17.2 Selecting the encoders via soft keys

17.2.1 Via the selection screen

When the PWM8 is switched on a selection screen is displayed in which the measuring system to be tested can be chosen.
The selected measuring system is highlighted in the soft-key row:

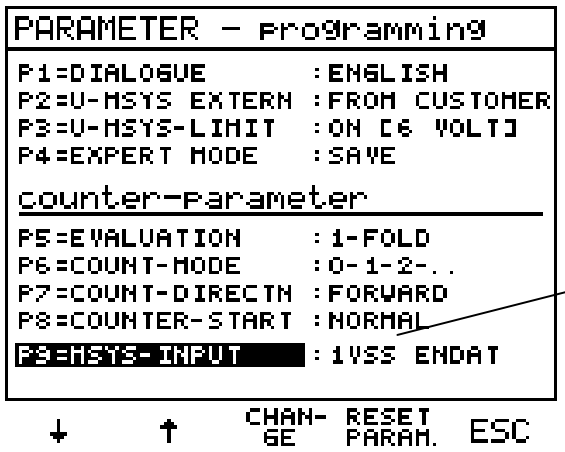


Press ESC to exit this screen. The display switches to the PWM8 operating mode. The selected measuring system is displayed in the PWM8 mode *INFO*.

Measuring systems that can be selected with this interface board:
1. 1Vpp encoder with Zn/Z1 incremental track AB selected
2. 1Vpp encoder with Zn/Z1 incremental track CD selected
3. 1Vpp encoder with EnDat or SSI interface
4. 1Vpp encoder with programmable SSI interface

17.2.2 Via parameter P9 in the EXPERT MODE

Changing the parameters of PWM8:
The parameters of the PWM8 can only be edited in the EXPERT MODE.
This mode is activated by simultaneously pressing the left and the right soft key while the power-on message of PWM8 is being displayed.
As soon as this mode has been started EXPERT-MODE is displayed together with the power-on message of PWM8.
The EXPERT MODE function can be stored in non-volatile memory by means of the parameter P4 *STORE EXPERT MODE* (see PWM8 Operating Instructions, Section EXPERT MODE).



Select parameter P9 using the arrow keys; press CHANGE to switch to the menu for encoder selection.
In this example:
1 Vpp encoder with EnDat interface

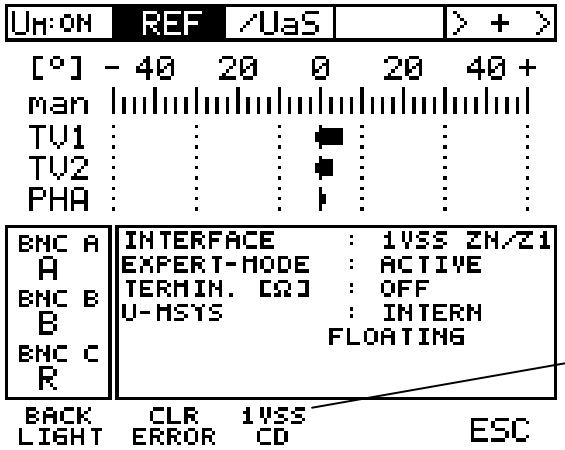
By pressing ESC in the menu for selecting the encoder input, the selected encoder is confirmed and the PWM8 parameter list exited.

17.2.3 Switching the AB and CD tracks for 1Vpp encoders with Zn/Z1

Note:

As of software version 11:

With these measuring systems the track signals AB and CD can be switched in the **INFO** soft-key row
Parameter programming is not required.

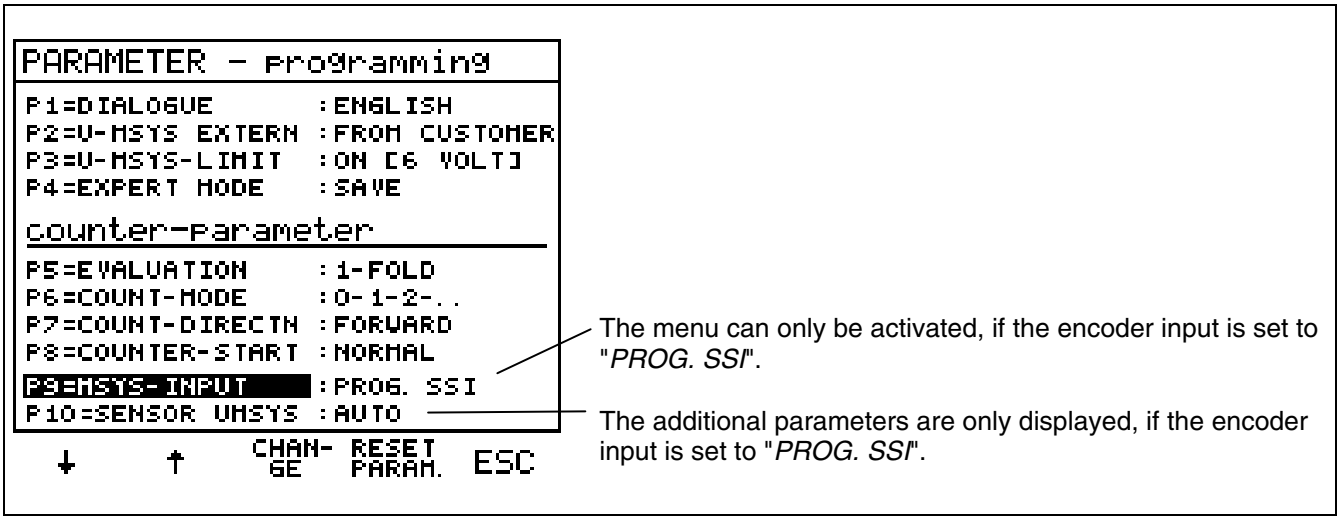


Possibility of switching between AB incremental track and CD commutating track in the INFO mode

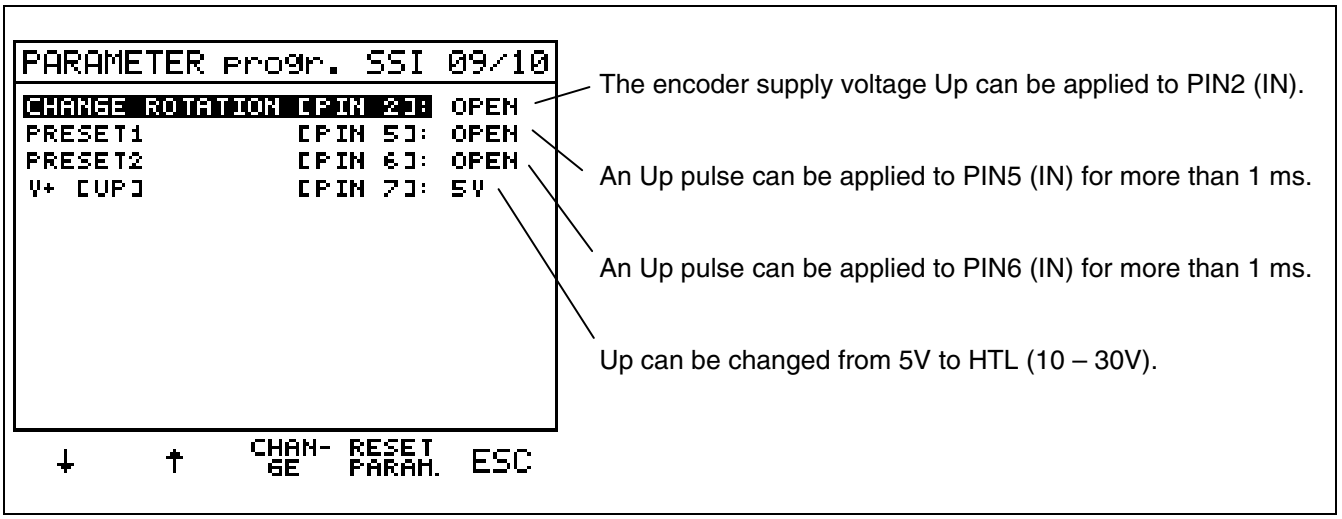
17.3 1 Vpp measuring systems with programmable SSI interface

17.3.1 Activating the menu for additional functions

A special menu needs to be activated to use the additional functions. For this purpose the encoder input must be set to "PROG. SSI" by means of the parameter P9.



To activate the menu for the additional functions, **now** (P9 = MSYS input: PROG.SSI) press the **three soft keys on the left** simultaneously.
Then the following options are available:

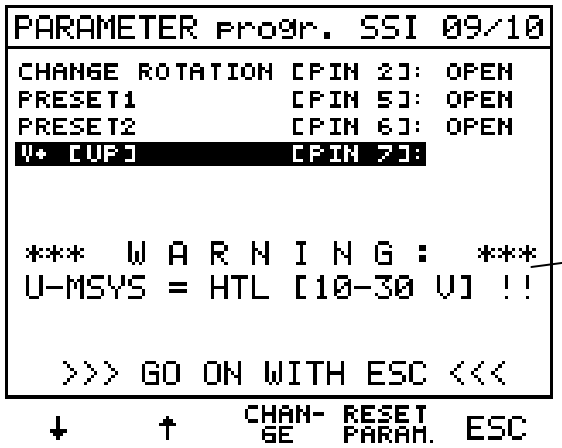


Press the ESC soft key to exit the menu of the additional functions.

17.3.2 Switching the encoder supply to HTL

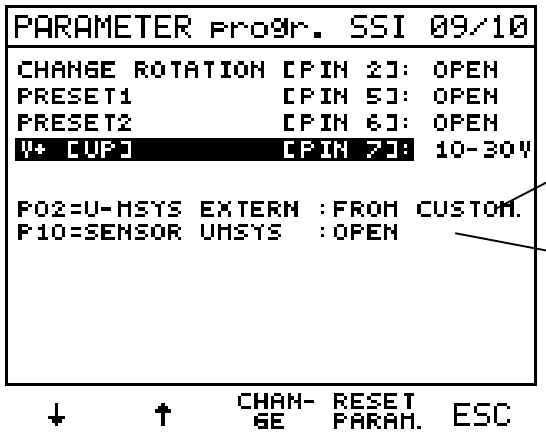
The encoder supply voltage can be switched to HTL (10 – 30V), if the soft key "***CHANGE***" is pressed while the parameter "*V+ [Up]*" is selected (highlighted).
For safety's sake a warning is displayed which needs to be confirmed by pressing the ESC soft key.

Note:
After a power interruption (PWM8 switched off) U_MSYS is always set to 5V; it must be set to HTL again by the operator, if required.



Safety precaution!
The encoder supply voltage has been set to HTL (10 – 30V). TTL (5V) measuring systems connected by accident would be destroyed in this operating mode.

After confirming this safety precaution with ESC, the internal PWM8 parameter settings are displayed.



HTL power supply is active.

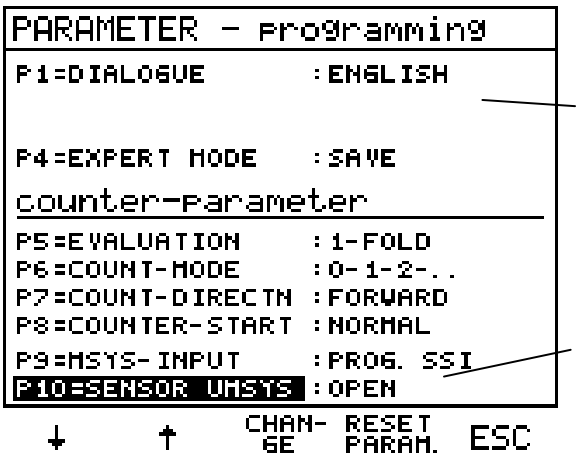
With HTL the encoders can only be powered externally "*FROM CUSTOMER*".

The sensor connection at the encoder input and at the encoder output of the interface board is opened such that the additional serial interface can be used.

If this parameter list is exited by pressing the ESC soft key, the parameter list for P1 to P10 is displayed again. As it is the rule with the HTL interface board, the parameters P2 and P3 are not available.

17.3.3 Parameter P10 "sensor connection" with programmable SSI encoders

When HTL encoder supply is activated when operating with 1Vpp encoders with programmable SSI interface, additionally the parameter "*P10=SENSOR UMSYS*" is available.
By means of the parameter P10 the operator can set the sensor connection at the encoder input and at the encoder output.



The parameters P2 and P3 are not available with HTL power supply.

If HTL power supply is active, the parameter P10 serves to set the sensor connection at the encoder input and at the encoder output of the interface board.

There are three different settings for the sensor connection:

auto The PWM8 itself is responsible for the sensor connections, depending on the selected PWM8 MODE. In the PWM8 MODE "*MEASURE U/I*" the sensor connection is opened at the encoder input such that the sensor voltages can be measured. At the encoder output the sensor connection is maintained; thus the voltage of the subsequent electronics is fed to the PWM8 on four lines. Owing to the double conductor cross section the voltage on the lines is reduced. In all other PWM8 MODEs there is a sensor connection at the encoder input and at the encoder output (reduced voltage on the power supply lines owing to double conductor cross section).
If the encoder is powered "*EXTERNAL FROM CUSTOMER*" (parameter P2), the sensor connections are opened at the encoder input and at the encoder output. The subsequent electronics can readjust the encoder supply voltage. if this feature is supported by the subsequent electronics.

open The sensor connections at the encoder input and at the encoder output of the interface board are open, i.e. the sensor lines are simply fed through PWM8.
This setting is required for 1Vpp encoders with programmable SSI interface and HTL power supply (additional serial interface via the sensor lines). Under these circumstances (P9 = „*PROG SSI*“) the PWM8 automatically set the parameter P10 to "*OPEN*".

connected The sensor lines at the encoder input and at the encoder output of the interface board are connected, i.e. the encoder is also powered via the sensor lines (the voltage is reduced owing to double conductor cross section).

Display of interfering signal:	A and B < 0.3 Vpp
Response time of the interface board	t1 approx. 5 µs
Response time of the PWM8 display	t2 > 1.2 µs

18 Specifications: Interface Board 1Vpp, absolute

18.1 Encoder input (IN)

Signal voltage:	5 Vpp max.
Input frequency for 1Vpp signals:	approx. 500 kHz

Note:
Higher input frequencies (up to 1 MHz) are possible; in this case the accuracy tolerance of the PHA/TV display can not be guaranteed any more!
The maximum input frequency only represents the cutoff frequency of the voltage input of the PWM8 input (signal source: frequency generator). In real operation with encoders the frequency response highly depends on the encoder connected and on the length of the cable.

18.2 Encoder output (OUT)

Output signal:	like input signal without U_0

18.3 Signal assignment of the BNC sockets

Max. frequency for the analog signals at the BNC sockets:	approx. 1 MHz (3dB)
1Vpp encoder, track AB	
Signals on BNC socket A	A, R, A
Signals on BNC socket B	B, A+B, B
Signals on BNC socket C	R, Up,/UaS EXE
1Vpp encoder, track CD	
Signals on BNC socket A	C, R, C
Signals on BNC socket B	D, C+D, D
Signals on BNC socket C	R, Up /UaS EXE
1Vpp encoder with EnDat or SSI interface	
Signals on BNC socket A	A, CLK+, DAT-
Signals on BNC socket B	B, CLK-, DAT+
Signals on BNC socket C	/UaS, Up, Up

18.4 Measuring encoder current/voltage

Measuring range for current:	0 - 500 mA
Measuring range for voltage:	0 - 30 V
Tolerance:	± 5 %

18.5 Measuring signal amplitudes

Measuring range:	0.2 V_{pp} – 1.6 V_{pp}
Measuring frequency:	10 Hz - 50 kHz
Tolerance without adjustment by software:	± 5 %
Tolerance with adjustment by software:	± 3 %

18.6 Display of /UaS interference signal

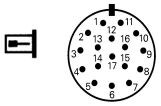
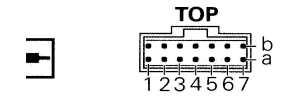
Track signal A and track signal B:	< 0.3 Vpp

18.7 Terminating resistors

Terminating resistor: tracks A, B	121Ω
Terminating resistor: tracks C, D	1kΩ
Terminating resistor: data, clock	not possible!

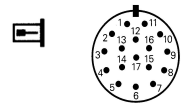
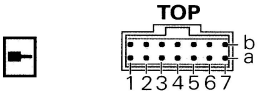
18.8 Pin layouts of drive encoders and absolute encoders

18.8.1 1 Vpp measuring system with Zn/Z1 track

17-pin HEIDENHAIN flange socket Interface board flange socket: IN Interface board flange socket: OUT					 PCB connector on encoder: 					
	15	16	12	13	3	2	7	10	1	4
	6b	2a	3b	5a	4b	4a	1b	5b	7a	3a
	A		B		R		5 V UP	0 V UN	5 V Sensor	0 V Sensor
	+	–	+	–	+	–				
	Green / Black	Yellow / Black	Blue / Black	Red / Black	Red	Black	Brown / Green	White / Green	Blue	White

	11	14	17	9	8	5	6
	-	7b	1a	2b	6a	-	-
	Internal shield	C		D		Temperature	
		+	–	+	–	+	–
	-	Gray	Pink	Yellow	Violet	Green	Brown

18.8.2 1 Vpp measuring system with EnDat interface

17-pin HEIDENHAIN flange socket Interface board flange socket: IN Interface board flange socket: OUT					 PCB connector on encoder: 					
	15	16	12	13	14	17	8	9	7	10
	2a	5b	4a	3b	6b	1a	2b	5a	1b	4b
	A		B		+DATA	-DATA	+CLOCK	-CLOCK	5 V UP	0 V UN
	+	–	+	–						
	Green / Black	Yellow / Black	Blue / Black	Red / Black	Gray	Pink	Violet	Yellow	Brown / Green	White / Green

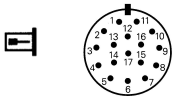
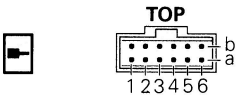
	11	1	4	3	2	5	6
	-	6a	3a	-	-	-	-
	Internal shield	5 V Sensor	5 V Sensor	n.c.	n.c.	n.c.	n.c.
	-	Blue	White	Red	Black	Green	Brown

Serial EnDat output signals

Being a bi-directional interface, the EnDat interface (**En**coder **Dat**a) of the absolute encoders can output absolute position values as well as request or update information stored in the encoder. Owing to serial data transfer, 4 signal lines are sufficient. The data transfer mode (position values or parameters) is selected via MODE commands which the encoder receives from the subsequent electronics. The data transfer is synchronized with the CLOCK signal given by the subsequent electronics.

Serial SSI output signals
With transfer of the absolute position information, the absolute position value is transferred synchronously to a CLOCK given by the control, starting with the most significant bit (MSB first).
According to the SSI standard the data word length is 13 bits for single-turn encoders and 25 bit for multi-turn encoders.

18.8.3 1 Vpp measuring system with programmed SSI interface

17-pin HEIDENHAIN flange socket Interface board flange socket: IN Interface board flange socket: OUT					 PCB connector on encoder: 					
	15	16	12	13	14	17	8	9	7	10
	A		B		+DATA	-DATA	+CLOCK	-CLOCK	10V-30V UP	0 V UN
	+	–	+	–						
	Green / Black	Yellow / Black	Blue / Black	Red / Black	Gray	Pink	Violet	Yellow	Brown / Green	White / Green

	11	1	4	3	2	5	6
	Internal shield	RxD	TxD	/Uas[1)]	Dir. of rotation	Preset1	Preset2
	-	Blue	White	Red	Black	Green	Brown

1): PWM8 displays the encoder error signal as /UaS2 (see also section: 1 Vpp encoders with programmed SSI interface)

Programmable SSI 09/10 encoders
HEIDENHAIN offers programmable versions of the multi-turn encoders ROQ 425, EQN 425 and single-turn encoders ROC 413, ECN 413. The following parameters and functions must be programmed via software:
- Single-turn resolution up to 8192 absolute positions per revolution. This allows for e.g. the adaptation to any screw pitch.
- Multi-turn resolution up to 4096 distinguishable revolutions, e.g. for the adaptation to any screw pitch.
- Direction of rotation for ascending position values.
- Output format of the position value: Gray code or dual code.
- Data format: synchronous-serial right-aligned or 25-bit partitioned data format (SSI).
- Offset and preset values for zero rest or compensation.

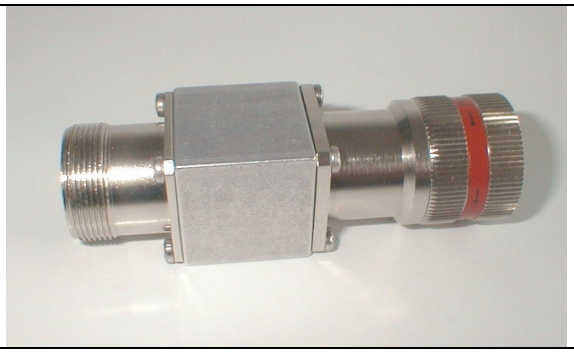
Some of these functions can also be activated by means of connecting elements:
- Direction of rotation for ascending position values.
- Setting the preset value defined by software programming.

Moreover, the HEIDENHAIN programmable multi-turn encoders feature a diagnosis function providing information on the current operating status. The PLC can evaluate an interference signal output on a separate line. Thus, the standstill time of the system can be reduced.

Details: see Operating Instructions
Software for programmable SSI encoders Id.No. 332434-10

18.9 Adapter kit for non-HEIDENHAIN wiring

To adapt PWM8 interface boards with Pos.Enc. wiring (position encoder) to motor encoder wirings Mot.Enc.1Vpp and Mot.Enc.EnDat (motor encoder 1Vpp / EnDat)



18.9.1 Adapter kit 1 (Zn/Z1) for operation with Siemens and JH drives with HEIDENHAIN Zn/Z1 encoders and non-HEIDENHAIN wiring

Kit 1: Adapter Zn/Z1 IN: Id.No. 349312-01 for flange socket IN of interface board

PWM8 side (Pos.Enc.1Vpp)	Signal	Color	Drive side (Mot.Enc.1Vpp)
Flange socket 17-pin, male			*Flange socket 17-pin, knurled coupling ring*
PIN 1	Up sensor	Blue	PIN 16
PIN 2	R-	Black	PIN 13
PIN 3	R+	Red	PIN 3
PIN 4	0V sensor	White	PIN 15
PIN 5	Temp.+	Green	PIN 8
PIN 6	Temp.-	Brown	PIN 9
PIN 7	Up	Brown/green	PIN 10
PIN 8	D-	Violet	PIN 4
PIN 9	D+	Yellow	PIN 14
PIN 10	0V	White/green	PIN 7
PIN 11	Internal shield	-	PIN 17
PIN 12	B+	Blue/black	PIN 11
PIN 13	B-	Red/black	PIN 12
PIN 14	C+	Gray	PIN 5
PIN 15	A+	Green/black	PIN 1
PIN 16	A-	Yellow/black	PIN 2
PIN 17	C-	Pink	PIN 6

Kit 1: Adapter Zn/Z1 OUT: Id.No. 349312-02 for flange socket OUT of interface board

Drive side (Mot.Enc.1Vpp)	Signal	Color	PWM8 side (Pos.Enc.1Vpp)
Flange socket 17-pin, male			*Flange socket 17-pin, knurled coupling ring*
PIN 16	Up sensor	Blue	PIN 1
PIN 13	R-	Black	PIN 2
PIN 3	R+	Red	PIN 3
PIN 15	0V sensor	White	PIN 4
PIN 8	Temp.+	Green	PIN 5
PIN 9	Temp.-	Brown	PIN 6
PIN 10	Up	Brown/green	PIN 7
PIN 4	D-	Violet	PIN 8
PIN 14	D+	Yellow	PIN 9
PIN 7	0V	White/green	PIN 10
PIN 17	Internal shield	-	PIN 11
PIN 11	B+	Blue/black	PIN 12
PIN 12	B-	Red/black	PIN 13
PIN 5	C+	Gray	PIN 14
PIN 1	A+	Green/black	PIN 15
PIN 2	A-	Yellow/black	PIN 16
PIN 6	C-	Pink	PIN 17

18.9.2 Adapter kit 2 (EnDat/SSI) for operation with Siemens drives with HEIDENHAIN EnDat/SSI encoders and non-HEIDENHAIN wiring

Kit 2: Adapter EnDat/SSI IN: Id.No. 349312-03 for flange socket IN of interface board

PWM8 side (Pos.Enc.EnDat)	Signal	Color	Drive side (Mot.Enc.EnDat)
Flange socket 17-pin, male			*Flange socket 17-pin, knurled coupling ring*
PIN 1	Up sensor	Blue	PIN 16
PIN 2	n.c.		
PIN 3	n.c.		
PIN 4	0V sensor	White	PIN 15
PIN 5	Temp.+	Green	PIN 8
PIN 6	Temp.-	Brown	PIN 9
PIN 7	Up	Brown/green	PIN 10
PIN 8	CLOCK+	Violet	PIN 5
PIN 9	CLOCK-	Yellow	PIN 14
PIN 10	0V	White/green	PIN 7
PIN 11	Internal shield	-	PIN 17
PIN 12	B+	Blue/black	PIN 11
PIN 13	B-	Red/black	PIN 12
PIN 14	DATA+	Gray	PIN 3
PIN 15	A+	Green/black	PIN 1
PIN 16	A-	Yellow/black	PIN 2
PIN 17	DATA-	Pink	PIN 13

Kit 2: Adapter EnDat/SSI OUT: Id.No. 349312-04 for flange socket OUT of interface board

Drive side (Mot.Enc.EnDat)	Signal	Color	PWM8 side (Pos.Enc.EnDat)
Flange socket 17-pin, male			*Flange socket 17-pin, knurled coupling ring*
PIN 16	Up sensor	Blue	PIN 1
	n.c.		PIN 2
	n.c.		PIN 3
PIN 15	0V sensor	White	PIN 4
PIN 8	Temp.+	Green	PIN 5
PIN 9	Temp.-	Brown	PIN 6
PIN 10	Up	Brown/green	PIN 7
PIN 5	CLOCK+	Violet	PIN 8
PIN 14	CLOCK-	Yellow	PIN 9
PIN 7	0V	White/green	PIN 10
PIN 17	Internal shield	-	PIN 11
PIN 11	B+	BLUE/BLACK	PIN 12
PIN 12	B-	RED/BLACK	PIN 13
PIN 3	DATA+	GRAY	PIN 14
PIN 1	A+	GREEN/BLACK	PIN 15
PIN 2	A-	YELLOW/BLACK	PIN 16
PIN 13	DATA-	PINK	PIN 17

18.10 Adapter cables for direct connection of PWM8 to the PCB connector of the encoder

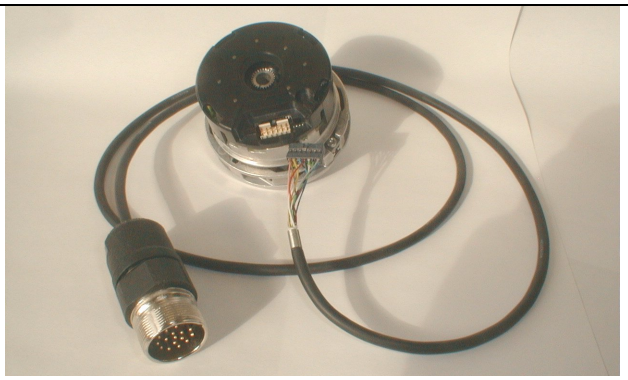
If the encoder is to be inspected with the cable assembly not known, the adapter cable with HEIDENHAIN wiring must be directly connected to the PCB connector!

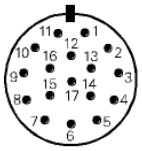
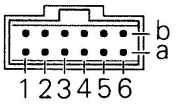
Note:
The 17-pin right-angle flange socket of the drive (encoder) may have <u>different assignments</u>!

18.10.1 Adapter cable with 12-pin PCB connector

for 1Vpp encoders with EnDat or SSI interface

Adapter cable Id.No. 349839-xx / EnDat/SSI

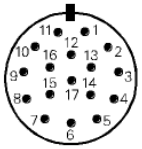
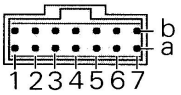


	**Signal**	**Color**	**TOP** 
Coupling 17-pin, male			*PCB connector 12-pin*
PIN 1	Up sensor	Blue	7a
PIN 2	n.c.	Black	-
PIN 3	n.c.	Red	-
PIN 4	0V sensor	White	3a
PIN 5	Temp.+	Green	-
PIN 6	Temp.-	Brown	-
PIN 7	Up	Brown/green	1b
PIN 8	CLOCK+	Violet	2b
PIN 9	CLOCK-	Yellow	5a
PIN 10	0V	White/green	4b
PIN 11	Internal shield	-	-
PIN 12	B+	Blue/black	4a
PIN 13	B-	Red/black	3b
PIN 14	DATA+	Gray	6b
PIN 15	A+	Green/black	2a
PIN 16	A-	Yellow/black	5b
PIN 17	DATA-	Pink	1a

Caution:
This cable is not intended for feed-through operation at the machine, since there are no lines for temperature monitoring! Observe the shield!

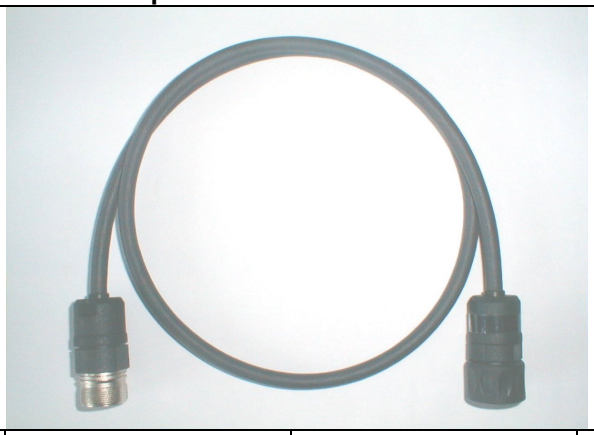
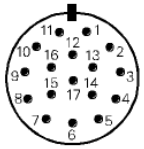
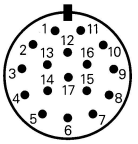
18.10.2 Adapter cable with 14-pin PBC connector

e.g. ERN 1387 with incremental track Zn and analog commutating track Z1

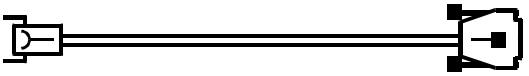
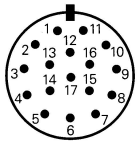
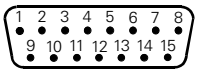
Adapter cable Id.No. 330980-xx / Zn/Z1			
			
	**Signal**	**Color**	**TOP** 
Coupling 17-pin, male			*PCB connector 14-pin*
PIN 1	Up sensor	blue	7a
PIN 2	R-	black	4a
PIN 3	R+	Red	4b
PIN 4	0V sensor	White	3a
PIN 5	Temp.+	Green	-
PIN 6	Temp.-	Brown	-
PIN 7	Up	Brown/green	1b
PIN 8	D-	Violet	6a
PIN 9	D+	Yellow	2b
PIN 10	0V	White/green	5b
PIN 11	Internal shield	-	-
PIN 12	B+	Blue/black	3b
PIN 13	B-	Red/black	5a
PIN 14	C+	Gray	7b
PIN 15	A+	Green/black	6b
PIN 16	A-	Yellow/black	2a
PIN 17	C-	Pink	1a

Caution:
This cable is not intended for feed-through operation at the machine, since there are no lines for temperature monitoring! Observe the shield!

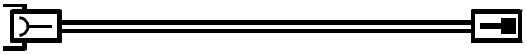
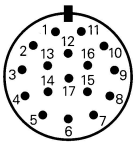
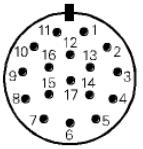
18.11 Adapter cable 17/17-pin; PWM to motor (Pos.Enc.EnDat)

Adapter cable Id.No. 323897-xx			
			
	**Signal**	**Color**	
Coupling 17-pin, male			*Connector 17-pin, female*
PIN 1	U_P – sensor or RxD	Blue	PIN 1
PIN 2	R- counting direction	Black	PIN 2
PIN 3	R+ or / UaS	Red	PIN 3
PIN 4	0V – sensor or TxD	White	PIN 4
PIN 5	+ Temp. preset 1	Green	PIN 5
PIN 6	- Temp. preset 2	Brown	PIN 6
PIN 7	U_P	Brown/Green	PIN 7
PIN 8	CLOCK+	Violet	PIN 8
PIN 9	CLOCK-	Yellow	PIN 9
PIN 10	0V	White/Green	PIN 10
PIN 11	Internal shield	-	PIN 11
PIN 12	B+	Blue/Black	PIN 12
PIN 13	B-	Red/Black	PIN 13
PIN 14	DATA+	Gray	PIN 14
PIN 15	A+	Green/Black	PIN 15
PIN 16	A-	Yellow/Black	PIN 16
PIN 17	DATA-	Pink	PIN 17
Connector housing	External shield	External shield	Connector housing

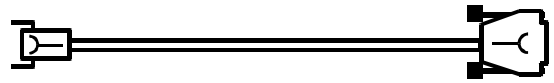
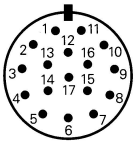
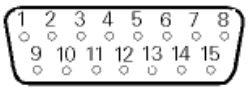
18.12 Adapter cable to IK 115 interface card

Adapter cable Id.Nr. 324544-xx			
			
	**Signal**	**Color**	
17-pin female connector			15-pin D-sub connector (male)
PIN 1	U_P sensor	Blue	PIN 12
PIN 2	Free	-	PIN 7
PIN 3	Free	-	PIN 14
PIN 4	0 V sensor	White	PIN 10
PIN 5	Free	-	-
PIN 6	Free	-	-
PIN 7	U_P	Brown/Green	PIN 4
PIN 8	CLOCK+	Violet	PIN 8
PIN 9	CLOCK-	Yellow	PIN 15
PIN 10	0V (U_N)	White/Green	PIN 2
PIN 11	Internal shield	-	PIN 6
PIN 12	B+	Blue/Black	PIN 3
PIN 13	B-	Red/Black	PIN 11
PIN 14	DATA+	Gray	PIN 5
PIN 15	A+	Green/Black	PIN 1
PIN 16	A-	Yellow/Black	PIN 9
PIN 17	DATA-	Pink	PIN 13
Connector housing	External shield	External shield	Connector housing

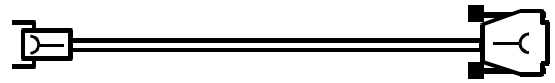
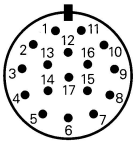
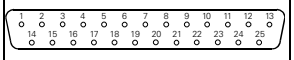
18.13 Adapter cable 17/17-pin; PWM to motor (Mot.Enc.EnDat)

Adapter cable Id.Nr. 340302-xx			
			
	**Signal**	**Color**	
17-pin female connector			17-pin male coupling
PIN 1	A+	Green/Black	PIN 1
PIN 2	A-	Yellow/Black	PIN 2
PIN 3	DATA+	Red	PIN 3
PIN 4	Free	-	PIN 4
PIN 5	CLOCK+	Green	PIN 5
PIN 6	Free	-	PIN 6
PIN 7	0V (U_N)	White/Green	PIN 7
PIN 8	Temp+	Yellow	PIN 8
PIN 9	Temp-	Violet	PIN 9
PIN 10	+V (U_P)	Brown/Green	PIN 10
PIN 11	B+	Blue/Black	PIN 11
PIN 12	B-	Red/Black	PIN 12
PIN 13	DATA-	Black	PIN 13
PIN 14	CLOCK-	Brown	PIN 14
PIN 15	0 V sensor	White	PIN 15
PIN 16	+V sensor	Blue	PIN 16
PIN 17	Internal shield (0V)	-	PIN 17
Connector housing	External shield	External shield	Connector housing

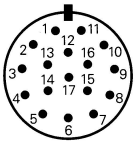
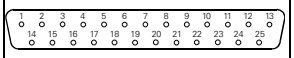
18.14 Adapter cable 17/17-pin; PWM to motor (Mot.Enc.EnDat)

Adapter cable Id.Nr. 332115-xx			
			
	**Signal**	**Color**	
17-pin female connector			15-pin D-sub connector (female)
PIN 1	Up Sensor	Blue	PIN 9
PIN 4	0V Sensor	White	PIN 11
PIN 7	Up	Brown/Green	PIN 1
PIN 8	CLOCK	Violet	PIN 14
PIN 9	CLOCK-	Yellow	PIN 15
PIN 10	0V (U_N)	White/Green	PIN 2
PIN 11	Internal shield	Internal shield	PIN 13
PIN 12	B+	Blue/Black	PIN 6
PIN 13	B-	Red/Black	PIN 7
PIN 14	DATA	Gray	PIN 5
PIN 15	A+	Green/Black	PIN 3
PIN 16	A-	Yellow/Black	PIN 4
PIN 17	DATA-	Pink	PIN 8
PIN 2	Free	-	10
PIN 3			
PIN 5			12
PIN 6			
Connector housing	External shield	External shield	Connector housing

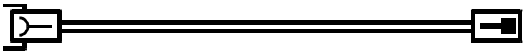
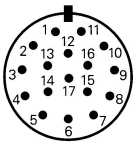
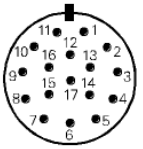
18.15 Adapter cable 17/25-pin; PWM to subsequent electronics (Mot.Enc.1Vpp)

Adapter cable Id.Nr. 289440-xx			
			
	**Signal**	**Color**	
17-pin female connector			25-pin D-sub connector (female)
PIN 1	A+	Green/Black	PIN 3
PIN 2	A-	Yellow/Black	PIN 4
PIN 3	R+	Red	PIN 17
PIN 4	D-	Pink	PIN 22
PIN 5	C+	Green	PIN 19
PIN 6	C-	Brown	PIN 20
PIN 7	0V (U_N)	White/Green	PIN 2
PIN 8	Temp+	Yellow	PIN 13
PIN 9	Temp-	Violet	PIN 25
PIN 10	+V (U_P)	Brown/Green	PIN 1
PIN 11	B+	Blue/Black	PIN 6
PIN 12	B-	Red/Black	PIN 7
PIN 13	R-	Black	PIN 18
PIN 14	D+	Gray	PIN 21
PIN 15	0 V sensor	White	PIN 16
PIN 16	+5 V sensor	Blue	PIN 14
PIN 17	Internal shield (0V)	Internal shield	PIN 8
-	Free	-	PIN 5
-	Free	-	PIN 9
-	Free	-	PIN 10
-	Free	-	PIN 11
-	Free	-	PIN 12
-	Free	-	PIN 15
-	Free	-	PIN 23
-	Free	-	PIN 24
Connector housing	External shield	External shield	Connector housing

18.16 Adapter cable 17/25-pin; PWM to subsequent electronics (Mot.Enc.EnDat)

Adapter cable Id.Nr. 336376-xx			
	**Signal**	**Color**	
17-pin female connector			25-pin D-sub connector (female)
PIN 1	A+	Green/Black	PIN 3
PIN 2	A-	Yellow/Black	PIN 4
PIN 3	DATA+	Red	PIN 15
PIN 4	Free	-	-
PIN 5	CLOCK+	Green	PIN 10
PIN 6	Free	-	-
PIN 7	0V (U_N)	White/Green	PIN 2
PIN 8	Temp+	Yellow	PIN 13
PIN 9	Temp-	Violet	PIN 25
PIN 10	+V (U_P)	Brown/Green	PIN 1
PIN 11	B+	Blue/Black	PIN 6
PIN 12	B-	Red/Black	PIN 7
PIN 13	DATA-	Black	PIN 23
PIN 14	CLOCK-	Brown	PIN 12
PIN 15	0 V sensor	White	PIN 16
PIN 16	+V sensor	Blue	PIN 14
PIN 17	Internal shield (0V)	-	PIN 8
-	Free	-	PIN 5
-	Free	-	PIN 9
-	Free	-	PIN 11
-	Free	-	PIN 17
-	Free	-	PIN 18
-	Free	-	PIN 19
-	Free	-	PIN 20
-	Free	-	PIN 21
-	Free	-	PIN 22
-	Free	-	PIN 24
Connector housing	External shield	External shield	Connector housing

18.17 Adapter cable 17/17-pin; PWM to motor (Mot.Enc.1 Vpp)

Adapter cable Id.Nr. 336847-xx			
			
	**Signal**	**Color**	
17-pin female connector			17-pin male coupling
PIN 1	A+	Green/Black	PIN 1
PIN 2	A-	Yellow/Black	PIN 2
PIN 3	R+	Red	PIN 3
PIN 4	D-	Pink	PIN 4
PIN 5	C+	Green	PIN 5
PIN 6	C-	Brown	PIN 6
PIN 7	0V (U_N)	White/Green	PIN 7
PIN 8	Temp+	Yellow	PIN 8
PIN 9	Temp-	Violet	PIN 9
PIN 10	+V (U_P)	Brown/Green	PIN 10
PIN 11	B+	Blue/Black	PIN 11
PIN 12	B-	Red/Black	PIN 12
PIN 13	R-	Black	PIN 13
PIN 14	D+	Gray	PIN 14
PIN 15	0 V sensor	White	PIN 15
PIN 16	+V sensor	Blue	PIN 16
PIN 17	Internal shield (0V)	-	PIN 17
Connector housing	External shield	External shield	Connector housing

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